THE DELTA ENGINEERS

A History of the U.S. Army Corps of Engineers in the New Orleans District

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DEDICATED

To the Men and Women of the New Orleans District

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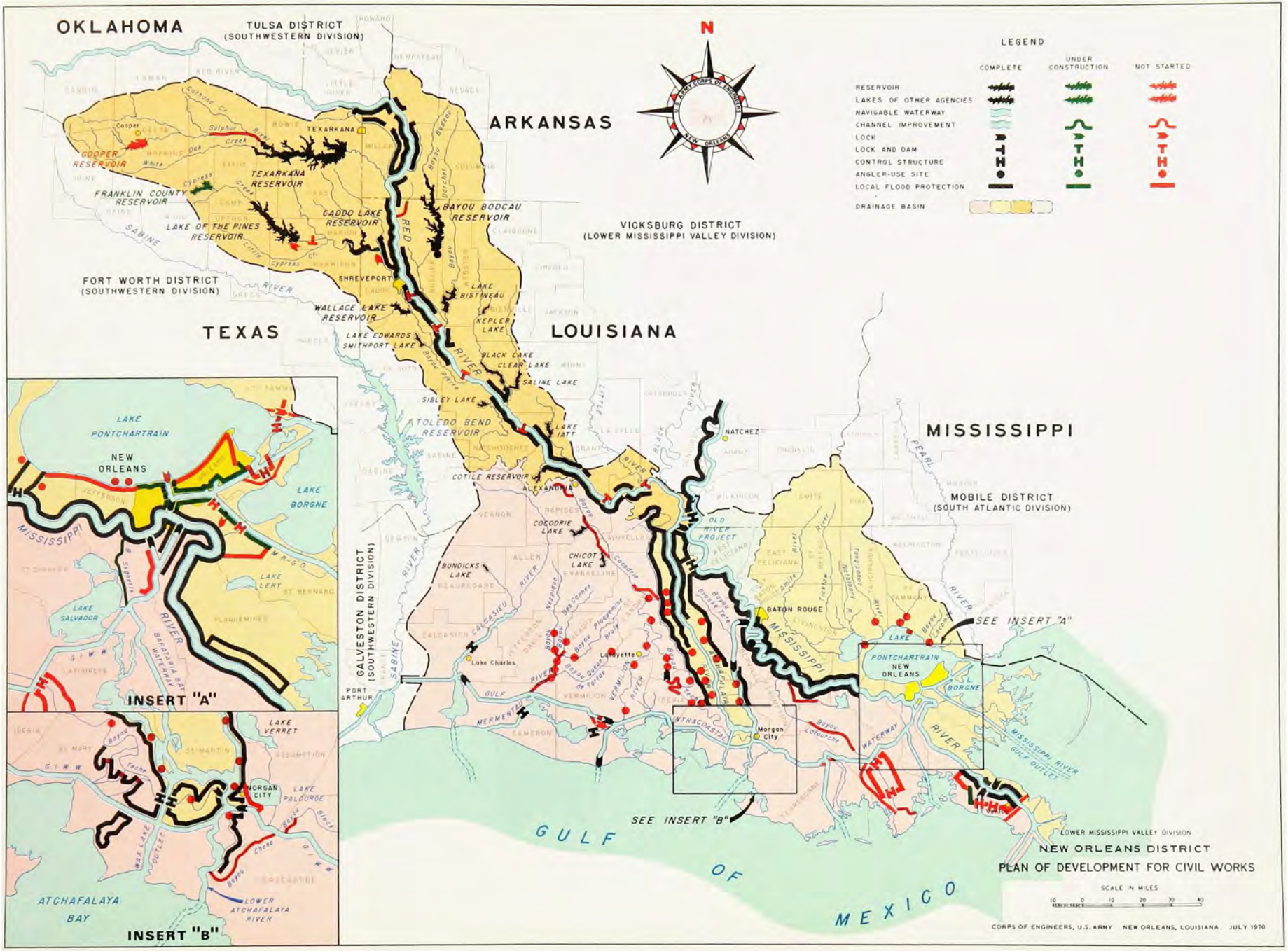
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BAYOU BODCAU RESERVOIR
WALLACE LAKE RESERVOIR
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FORT WORTH DISTRICT
(SOUTHWESTERN DIVISION)
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(LOWER MISSISSIPPI VALLEY DIVISION)
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COTILE RESERVOIR
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NATCHEZ
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CHICOT LAKE
BUNDICKS LAKE
OLD RIVER PROJECT
MOBILE DISTRICT
(SOUTH ATLANTIC DIVISION)
GALVESTON DISTRICT
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NEW ORLEANS DISTRICT
PLAN OF DEVELOPMENT FOR CIVIL WORKS
SCALE IN MILES
CORPS OF ENGINEERS, U.S. ARMY NEW ORLEANS, LOUISIANA JULY 1970

THE DELTA ENGINEERS

A History of the United States Army Corps of Engineers

In the New Orleans District

By

Albert E. Cowdrey

1971

FOREWORD

As the U. S. Army Corps of Engineers approaches its two hundredth anniversary, its districts and divisions, at the direction of the Chief of Engineers, have undertaken to explore their own past and prepare histories of the work which they have carried out in the service of the United States. The undersigned soon after his arrival in July 1968 directed the preparation of an interim pamphlet size abbreviated history to be followed by a detailed history in depth as soon as a qualified historian could be employed.

In March 1970 the New Orleans District engaged the services of a professional historian to unravel its own long and intricate history. Dr. Cowdrey has produced a fine account of the District, its achievements and problems. Some of our people would have preferred a more personal record, others a more technical account of the engineering concepts which underlie our work. Instead he has viewed the Delta Engineers as a living organization, to be related both to the development of the national Corps and to the broad movements of American history.

The document that follows is more than just a history of the New Orleans District — it is also a history of the waterways of Louisiana from the first arrival of civilized man to the present time. It is a work in which all those who have played a part in the work of the district, both past and present, can take pride.

Herbert R. Haar Jr.

1 May 1971

HERBERT R. HAAR, JR.
Colonel, CE
District Engineer

ACKNOWLEDGEMENTS

While the author alone is responsible for the interpretations advanced in this work, and for any errors which may occur, he acknowledges fully that whatever is useful in it belongs in large part to the many people, in and out of the Corps, who assisted him. In Washington he had the assistance of Robert W. Blakeley, Chief of the Office of Administrative Services; of Dr. Jesse Remington, Lenore Fine, and Eugene McAndrews of the Corps' Historical Division; and of Dr. Madeleine J. Wilkins of the Corps Library. Drs. Charles Roland of the University of Kentucky, Gerald Capers of Newcomb College, and Bennett Wall of Tulane provided much invaluable criticism. Without Prof. Chester Peyronnin of the School of Engineering at Tulane University, the work would not have been written. In the New Orleans District, the District Engineer, Col. Herbert R. Haar, Jr., not only presided over the project, but gave much of his time and energy to seeing it through. Warren B. Dodd, the Executive Assistant to the New Orleans District Engineer, did more than any other individual except the author in making the history possible.

Thanks are also due to Elmer O. Parker of the Old Military Records Division of the National Archives; to Ernest Blankenship and Margaret Palmer of the Mississippi River Commission; to Bruce Sossaman, the Public Affairs Officer of the New Orleans District; to Daniel Alloy, the District's Records Management Officer; to Dora Levy, who prepared the manuscript; to Eileen Smith, whose helpfulness to a newcomer at the District office was deeply appreciated; to the members of the District, past and present, who granted the interviews cited in these pages; and especially to Dewey Coulon, who handled the technical side of production in a manner that deserves all praise. As for the many others who assisted, but whose names cannot even be listed here, the dedication of this volume will have to serve as the author's acknowledgement of their skill and efforts, freely given.

ALBERT E. COWDREY
New Orleans, 1971

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In the time scale of geology, the Mississippi River as we know it is something new under the sun, though 150 million years have passed since the faulted bedrock beneath what is now the Alluvial Valley settled, producing the Mississippi Embayment.

Into this great geologic trough flowed the Cretaceous sea, as far north as modern Illinois. For tens of millions of years, small rivers poured alluvium into this great inland bay, but the major drainage of the American Middle West, halted by low hills to the south, continued to run north into the St. Lawrence. Then the glaciers of the last Ice Age advanced, and the edge of the glaciers, at about the line of the present Missouri and Ohio Rivers, streams ponded, merged, and sought a new outlet to the south. The falling sea level caused by the formation of the ice sheet had meantime emptied the Embayment, and across this land, which had lately been sea-bottom, a new river began to incise its course. This was the earliest Mississippi; the time was only about 1 million years ago.[1]

During the Ice Age the level of the sea rose and fell as the glaciers periodically melted and formed anew, and these changes were written into the valley of the Mississippi. When the sea retreated the river cut deep braided channels into the marine deposits; returning after ages of high water, it buried its own former channels in fresh alluvium. In time, despite the melting of the glaciers and the consequent rising of the sea, the Embayment was filled with alluvium, and the Mississippi took its present form, a stream meandering in broad loops across the surface of a great wedge of clay and sand.[2] The present layer of earth was laid down in the last 30,000 years, and the present Delta of the river — not only the outlet through Plaquemines but the five former outlets that can be traced upon the surface sediments — belong to the past 10,000 years.[3] The Father of Waters is a geologic child.

The forces that have shaped the land are still at work. The sediment that fills the Embayment has continued to warp and depress the faulted bedrock. The greatest earthquake ever recorded on the North American continent was a settling of the Mississippi Structural Trough near New Madrid, Missouri, in 1811. The last attempt of the Mississippi to form a new outlet was frustrated by the works of man in the mid-twentieth century. The land which the Mississippi built continues to change, as Lafacadio Hearn wrote, "more slowly, yet not less fantastically, than the clouds of heaven."[4]

The Alluvial Valley or flood plain of the Mississippi runs south from Cape Girardeau in the Commerce Hills of Missouri, a region of rich bottom lands averaging 50 miles in width and about 600 miles long. Here, long before the coming of civilized man, the river had established its own unique "regimen." In times of low water the river ran in a channel bounded by "natural levees" raised above the level of the plain. These levees were formed because the heaviest burden of silt precipitated near the edges of the river during overflows. During great floods, on the other hand, the whole flood plain became the channel of the Mississippi — 28,000 square miles of swamp and forest which played an essential part in the river's functioning.[5]

The swamps were natural reservoirs that prolonged but mitigated floods by retaining vast quantities of water during rises and releasing it again when the river fell. Near the Gulf a system of outlets existed — Bayou Plaquemine, Bayou Manchac, Bayou Lafourche, the Atchafalaya River. Flooding was a natural, almost yearly phenomenon, not a devastating occurrence at intervals of

decades. Utilizing its flood plain, the river expanded or contracted according to need. Throughout its course it constantly changed its bed, yet retained an approximately stable length. Always eroding the concave banks of its many turns, the Mississippi gradually shaped them (wherever the land would allow) into immense nooses. Then, in times of flood, it cut off one or more noose, shortening its length by as much as 15 miles. But within its new, direct channel the velocity would increase, undermining some weak bank below the cutoff. The increased erosion below soon compensated for the length that had been lost upstream. The bends of the natural Mississippi migrated southward over the course of ages, yet the net effect was a rough balance among the forces that were shaping its course to the sea.

When men set about building a civilization in the flood plain, they had to interfere with many parts of this process. Unless they were willing to give up both agriculture and industry and live at a subsistence level like the Indians, the river had to be restrained. To raise its natural levees was the simplest and cheapest course, and the first civilized men had hardly settled in the Valley before they adopted it. Yet the levee system cut across the regimen of the river at almost every significant point. The river's prime work of land-building ceased with the seasonal overflows. The river in flood was denied use of the Alluvial Valley and confined to its low-water channel, plus whatever additional cross section the levees themselves could provide. The swamp reservoirs were cut off. For various reasons the distributaries were tampered with.

Inevitably, the waters rose as they were constricted. Pressures against the levees increased. Floods ceased to be yearly phenomena at the cost of becoming infrequent catastrophes. During great floods the whole immense mass of water, moving at great velocity, debouched upon the Delta. Here the developments taking place on the whole river registered their combined effect.

The deltaic plain is the part of the Valley in which major tributaries cease to enter the river and distributaries begin to leave it.[6] Above the deltaic plain the points of land where the Mississippi meets with other streams point south; within it they point north. By this reckoning the Delta begins at Old River, above Baton Rouge, where the Red River entered and the first and greatest distributary, the Atchafalaya, left the Mississippi.

The Delta is a curious landscape. Nine-tenths of the world is sky. The land looks absolutely flat, and near the sea breaks up like a puzzle into the streams and hummocks of the salt marsh. Vulnerable to the rising water brought by the river and to the wind and falling water of tropical storms, all human society is shaped in some degree by an environment in which "the earth is mostly water and the water mostly earth." Here civilization is maintained by artifice in a region where Nature might reasonably have asked a few more eons to finish a work of creation that is still incomplete.

In the Delta one organization had been of prime importance in making the *tour de force* of civilization work. The United States Army Corps of Engineers has had the job of dividing the water from the dry land in a place where the two most persistently want to mingle. The Engineers have been charged with opening the streams to commerce, protecting farmlands and cities from flood, and cleaning up the ruin after storms. Above all they have had to deal with the great river in all its moods — and as Mark Twain said, one "might as well bully the comets in their courses . . . as try to bully the Mississippi into right and reasonable conduct."[7] They have been at work since the Louisiana Purchase in 1803, and during that time their achievements and failings, their

blind spots and sometimes brilliant insights, have written much of the Delta's history.

Some 3 million people now inhabit the New Orleans District. The population is growing, the cities spreading. But every Engineer knows that underneath this visible Delta there is a substructure, little noticed by visitor or resident — the delicate artifice of flood and storm control which makes human settlement possible at all.[8]

CHAPTER ONE: THE AGE OF LOCALISM

Columbus may have seen the mouths of the Mississippi during the course of his mysterious fourth voyage. At any rate, the River of Palms shown on the "Admiral's Map" in the Spanish archives has been called the first picture of the Passes of the Mississippi ever drawn.[1] DeSoto did see the river, as we all learned at school, and after his death his followers became the first Europeans ever to witness a Mississippi flood — a great one, too, that lasted for 80 days and drowned the land to the branches of the tallest trees.[2] But the explorations of the Spanish left no mark outside their chronicles. It was left to the French to perform the two most typical works of man: to name the land and to change the land.

Late in the seventeenth century, French exploring parties probed downriver from Canada and westward along the Gulf Coast from Mobile Bay. The first certainty that the great river which LaSalle had followed south from Canada was the same that emptied through the Mississippi Delta came when Iberville found in an Indian village letters left for LaSalle by Tonti, his iron-handed lieutenant. With a growing sense of a great empire beckoning to them, the French explored, built forts, made treaties with the Indians, and scattered the Delta with the names that have clung to it ever since. When, in 1717, Bienville decided to move his capital from "the sterile lands of *Biloxi*, *Mobile*, and *St. Louis Bays*, to the rich country bordering the Mississippi,"[3] he started the work of land-changing which has continued to this day. For the land he chose, though higher than the surrounding swamp, was subject to overflow and had to be protected if it was to be inhabited at all.[4]

The Sieur de la Tour, first of the Delta's engineers, examined the site of New Orleans, where so many would work after him. He found "only . . . some unimportant houses, scattered here and there, made by voyageurs who had come down from Illinois." The region seemed so unfavorable that he protested against establishing the capital there; overruled by Bienville, he had a "pretty long and wide" strip cleared along the river and set to work.

> . . with the help of some piqueurs, he traced on the ground the streets and quarters which were to form the new town, and notified all who wished building sites to present their petitions to the council. . . . It was ordained that those who obtained these plots should be bound to enclose them with palisades, and to leave all around a strip at least three feet wide, at the foot of which a ditch was to be dug, to serve as a drain for the river water in time of inundation. The Sieur de la Tour deemed these canals, communicating from square to square, not only absolutely necessary, but to preserve the city from inundation, raised in front . . a dike or levee of earth, at the foot of which he dug a similar drain.[5]

By 1727, New Orleans had a levee over a mile long, a yard high, and 18 feet wide at the top.[6] Until the river and the swamp reclaim it, the city will never be without these walls of earth again.

As the levees grew, the French introduced in 1724 the idea that the riparian landholders should be held responsible for maintaining them. The reason, of course, was that the people settled first on the high lands of the natural levees. Not only were these lands safer from floods, they were exceptionally fertile, for the river deposited large-particled soil, loam or loess, upon the banks and carried the finely-divided and much less fertile and workable clays into the backlands. Heavy mists flowed into the lowlands and crops saturated with heavy dews could be killed by a brief dip

A few isolated levees were constructed before 1844 on the west bank north of the Arkansas River.

Many isolated levees were constructed in the Yazoo Basin by 1844.

THE DEVELOPMENT OF THE LEVEE SYSTEM

(Main River Levees only)

LEGEND

- Levees built before 1735
- Levees built between 1735 and 1812
- Levees built between 1812 and 1844

Scale: 10 5 0 10 20 30 40 50 MILES

Note:
Extent and location of levee lines approximate.

of the temperature below the freezing point. But as the backlands were settled, riparian dwellers increasingly resented the servitude written into their deeds. The practice of entrusting vital and very expensive public works to individuals meant that low, weak levees built to no standard and maintained with ignorance and ill grace became the rule.

The flood of 1735, marked not only by its high stages but by its six-month duration, destroyed most of the levees in the young colony. The landholders were evidently remiss in replacing them, for an ordinance of 1743 threatened them with forfeiture of their property unless the levees were completed by the first of the following year. By 1770 plantations extended only 30 miles above and 20 miles below New Orleans, a measure which apparently had not changed for 20 years. Lack of settlers and unsuccessful wars by the French and Spanish rulers against the English combined with the difficulties imposed by nature to inhibit the growth of Louisiana.

The Louisiana Purchase brought a huge influx of new settlers, and with them the usual nineteenth-century American mixture of energy and disorganization. It also brought a new war against Louisiana's old enemy, England. In the year that the state was admitted to the American Union, the War of 1812 broke out. In 1815, the Chalmette plains below New Orleans became the site of the last major battle of the war. This was fitting, for the struggle of the years 1812-1815 brought changes to all the states of America, but to Louisiana perhaps more than any. It marked a change in Federal policy, and an epoch in the Corps of Engineers of the American Army, which ultimately were to transform the state more than many battles.

Despite the exploits of Perry on the Lakes and of Jackson at New Orleans, the war by and large was a humiliating affair. Every failing of American society and every weakness of American arms was mercilessly revealed. American soldiers often fought badly. The huge country was still mostly wilderness, and moving troops to any spot threatened by an enemy was a slow and costly business. Jackson's presence at New Orleans was as much a matter of luck as of management. And danger did not come only from outside. Sectional loyalties were strong, and a party of New Englanders tried to secede from the Union when the war ruined their trade. Since one of the few laws of history is that everybody prepares for the last war, the peace was hardly signed when America began to make preparations for an "inevitable third war" against England. The lessons of 1812-1815 were studied by national leaders with added urgency because they were convinced that a new war would be fought, and that it would be essentially a replay of the one just past.

From this belief grew a new program for America, masterminded by such men as Henry Clay, John Q. Adams, and John C. Calhoun. To protect the country against the British fleet, the seacost must be ringed with defenses. To bind its people together a national system of communications must be built. A new kind of government would be needed to carry out this program. Vast works which promised little immediate profit would have to be financed by the Federal Government or the states. And since the United States was an undeveloped country, where skill went at an even higher premium than capital, the Army Corps of Engineers began to take on a variety of unaccustomed duties.

The Engineers had first made their appearance in 1775, when the state of Louisiana was still a Spanish colony. On the day before Bunker Hill the Continental Congress had provided for one chief engineer and two assistants to be assigned to the army. Late in 1776, Washington had been authorized to

raise a corps of engineers to serve for 6 months.[7] The Corps was formally organized in 1779, but disbanded after the conclusion of peace in 1783. There were short-lived revivals in the 1790's when war threatened again, but the modern Corps of Engineers was not created until 16 March 1802. Then the President was authorized by Congress to establish a Corps of Engineers of 16 officers and 4 cadets, who "shall be stationed at West Point, in the State of New York, and shall constitute a Military Academy; and at all times to do duty in such places and on such service as the President of the United States shall direct."[8]

At its beginning, then, the Corps *was* West Point, and the Military Academy, deeply influenced by French models, professors and texts, formed the only school of engineers in the United States until the establishment of Rensselaer Polytechnic in 1824.[9] A French visitor remarked in the 1830's that "the greatest difficulty which the American encountered in the execution of their public works, was not to procure the necessary capital, but to find men capable of directing operations." As he also noted, the "officers of the engineer corps and of the topographical engineers" were those who filled the need.[10]

In any program of national defense, Louisiana — newly acquired, remote, rich, vulnerable, the site of a British invasion — would inevitably be one of the first points to be protected. Fortunately, the Corps of Engineers was already familiar with the region. Apparently Maj. Decius Wadsworth had been the first officer of the Corps — then 1 year old — to be sent to Louisiana at the time of the Purchase.[11] He had investigated the defenses of the territory, and in 1804 had reported his findings to Brig. Gen. James Wilkinson at Washington.[12] The Corps had entered Louisiana in a purely military role, and this role changed only gradually as the Corps itself evolved.[13]

It was on 21 March 1815 — less than 3 months after the Treaty of Ghent was signed, ending hostilities — that Brig. Gen. Joseph G. Swift, the Chief of Engineers, got the new program underway. He wrote Secretary of War A. J. Dallas that he had made arrangements for sending

> . Officers of Engineers to the various Important Ports and harbors between Maine & New Orleans, for the purpose of Inspecting, and Reporting fully upon, the present state of Fortifications — and to select, if requisite, judicious Sites for New Works to protect the principal positions on the Sea Board & the avenues to them. — I have commenced upon the above plan by sending an Officer of Engineers to South Carolina & Georgia, & I have Officers ready to proceed to Mobile and New Orleans — I shall retain this office in N.Y. 'til I receive your orders upon this subject —[14]

Lt. Hyppolyte Dumas was dispatched to Mobile and New Orleans after Dallas approved these orders, and the next year Lt. James Gadsden followed, evidently as Dumas' superior. Repairs were started on Fort St. Philip and Fort St. John, but before long Lt. Dumas, for reasons which are not clear, was arrested and tried by court-martial. Gadsden, on the other hand, was promoted to captain and by November 1818 had received the title "Superintending Engineer for the Gulf of Mexico Frontier." By this time Florida had been ceded by Spain, and Gadsden was reporting to Gen. Andrew Jackson, commander of the Department of the South, on the conditions of the Florida fortifications, especially of Barrancas in Pensacola harbor.[15] Thus the work of the Engineers in Louisiana began to take shape. Their first responsibility was to fortify the nation's soft underbelly; the Gulf region was to be treated as a unit, and placed under a superintending engineer. This pattern would remain unchanged until the 1850's.

Meantime the plan for unifying the nation by construction a network of national roads and canals was taking form. A grand design which involved both high national policy and the opportunity to cater to powerful local interests, the "internal improvements" program seemed to be the wave of the future. However, the program quickly brought government into close partnership with private capital — a partnership that was bound to arouse the suspicion of farmers and mechanics. The creation of a new national bank in 1816 annoyed speculators and debtors, while the concentration of power at Washington that the program implied went against the grain of a nation that was still strong in its local and sectional loyalties. For all these reasons the program that Clay was later to name the "American System" ultimately failed. But during its brief days of fame and prospective success, the program of Federally financed internal improvements changed the nature of the Corps of Engineers forever.

In 1816, on the authorization of Congress, President Madison employed Simon Bernard, one of Napoleon's best engineers, and assigned him to the American Corps of Engineers with the rank of brigadier general. A Board of Engineers for Fortifications was then created, with Bernard a member. Despite considerable jealousy from his American colleagues, Bernard played a decisive part in the development of the Corps during the succeeding decade.[16] Bernard and his fellow members of the Board embarked on an exhausting program of travels about the country, beginning at New Orleans in February 1817.[17] Here Captain William T. Poussin, a Topographical Engineer, joined him the following month.[18] Together with Lt. Col. Joseph G. Totten, another member of the Board, these officers would have an important role in forming national policy when Congress turned its eyes upon the Mississippi and began to assign civil works activities to the Corps.

Meantime the proposed fortifications near New Orleans were gotten underway. Evidently Bernard, Gadsden, and a third officer formed a board of "Commissioners on the Gulf of Mexico Frontier" and recommended the sites to be fortified near New Orleans. Gadsden was appointed to superintend the work, which the Chief of Engineers enumerated as "the Works at Mobile Point, at the Rigolets, at Chef Menteur, at Plaquemine[s] and at Grand Terre." He was promised "such assistants as the strength of the Corps will permit," and the Chief of Engineers undertook to advertise for proposals to furnish "Brick & Stone & Workmen at Mobile, Lake Pontchartrain, River Mississippi & Lake Barataria."[19] A contract for the fortification work was signed with Nathaniel Cox as "Agent (of) Fortifications" at New Orleans. Provision was made to spend about $43,000 per month for "nearly three years," according to the optimistic first estimate of the Chief of Engineers.[20] The future Forts Jackson, Macomb, Pike, and Livingston were undertaken as part of the national program which also provided for a fort in Charleston Harbor, later to be named Sumter.[21]

Meantime Congress, under the urging of representatives from the developing west, began to make some provision for exploring, mapping, and clearing obstructions from the Mississippi and its tributaries. The traffic of the river was swelling as its borderlands were settled. The farmers of the vast, rich Ohio country were still shipping their produce to New Orleans by keelboat, but in 1811 the steamboat began its great career upon the western rivers. Its maneuverability, its speed, and its capacity for moving rapidly upstream made it uniquely valuable. In 1819 Congress authorized a survey by the Engineer Department of the tributaries of the Mississippi,[22] and in 1820 it provided $5,000 for a survey of the Mississippi and Ohio, "for the purpose of facilitating and ascertaining the most prac-

ticable mode of improving the navigation of those rivers."[23]

This survey was carried out during the last 3 months of 1821 by Capt. Young, Capt. Poussin, and Lt. Tuttle under the direction of the Board of Engineers. The river was mapped with considerable thoroughness from St. Louis to New Orleans. Though the failure to publish the maps made the information useless to those who had to navigate the river, the report of the Board, based largely upon the work of these officers, was decisive in influencing Congress to undertake the clearance of the river. Bernard and Totten's report, submitted at the end of 1822, described the main danger to navigation as the snags, or dead trees, toppled into the river by caving banks. Some of these, called "planters," became fixed in the bed of the stream; others, called "sawyers," were more loosely anchored, and oscillated with the current just below the surface of the water. A mass of snags formed a "raft," like the famous one which obstructed Red River. Though by later standards the report was superficial and rather blasé about dangers to shipping (steamboat pilots were simply recommended to exercise "constant watchfulness" and not to travel at night) much of its language passed into the report of a House committee which recommended government action.[24]

Armed with this report, Westerners and Southerners argued that the navigation of the great river was as much a national concern, and as deserving of the taxpayer's dollar, as ocean commerce. The House bill passed handily, and on 24 March 1824 President James Monroe signed into law the first act by which the Federal Government officially involved itself with the improvement of the Mississippi River.[25] Seventy-five thousand dollars was appropriated to enable the Government to build and operate snag boats to clear the Mississippi from the mouth of the Missouri to New Orleans, and the Ohio from Pittsburgh to its junction with the Mississippi. This work was continued with some interruptions until 1854, and was the first step toward ultimate Federal responsibility for maintaining a navigable channel in the central river system. For lower Louisiana — where the great depth of the river made snags no problem — its chief significance lay in the boost it gave commercial development, especially at New Orleans, the river's entrepot. In addition, the act opened the possibility of future Federal action on the snag-ridden Red River, once the work had become established as national policy.

This work on the rivers formed part of a generally expanding interest in internal improvements throughout the nation. What might be called the organic law of the new policy was the Survey Act of 30 April 1824, which authorized the President to employ the Corps of Engineers to draw up surveys, plans and estimates "for the routes of such roads and canals as he may deem of national importance, in a commercial or military point of view, or necessary for the transportation of the public mail . "[26] The language of the act clearly reflected the new, close ties with private capital and members of the Engineers, especially the Topographical Engineers, were loaned to private companies whose activities were supposed to be of national interest. In this capacity the Engineers surveyed, among other works, the Chesapeake and Ohio Canal and "the rail road from Baltimore to the waters of the Ohio" — the first real railroad to be built in America.[27] In addition, work progressed under Engineer guidance on the Cumberland National Road, surveys for the improvement of the Tennessee River at Muscle Shoals, and for a proposed canal across Florida. A national road from Washington to New Orleans, also projected, bogged down in political squabbles among the proponents of four competing routes.[28] Considering that at this time the Corps consisted

of 22 officers and 10 full-time Topographical Engineers, the ubiquity of its members and the importance of their activities are astounding.[29]

Yet it remains true that the program of internal improvement, and the plans and hopes of the Corps for an indefinite expansion of their numbers and activities were politically premature. The coming of Jacksonian Democracy initiated a change in policy that delayed a full-scale program of national development through the agency of the Engineers until the Civil War.

Jackson emerged as the popular spokesman of all the interests which did not share in the benefits of the American System. He broke up the alliance between government and business, crushed the Bank of the United States, and condemned Federal partnership with private capitalists. He proposed to turn the job of improvement over to the States, and vetoed a test bill giving Federal aid to the Maysville Road Company in Kentucky. Since the Maysville Road would have run past the plantation of his arch-enemy Henry Clay, there was some question of personal spite about the veto.[30] Later, however, Jackson developed a set of standards to be applied by the Engineers to future projects which seemed to go beyond the politics of personal revenge. Henceforth, he ruled, projects of internal improvement were to receive the aid of the United States only if they related to the seacoast, to navigable waterways, or to the transshipment of foreign commerce in some clear and direct way. Then, to drive home his point, he vetoed a boondoggle-laden Rivers and Harbors Act, and threatened to do the same with others in the future.[31]

It will surprise no one familiar with the ways of politics to learn that Jackson's administration backed many activities of precisely the sort which the President condemned. Indeed, the historian Forrest Hill has found that by contrast with his successors Jackson was rather favorable to internal improvements.[32] Yet his administration did mark a turning point, after which such projects increasingly fell victim to constitutional scruples, state jealousy, and sectional conflicts. A law of 1838 forbade Topographical Engineers to work for private companies.[33] By 1840 survey work for the railroads had ended and was not resumed until the Pacific railroad surveys of the 1850's. Other forms of improvement suffered even more than the railroads, which brought in the kind of profits that could attract private capital and local aid. The failure of Congress to make appropriations several times interrupted the work of the snagboats and in 1855 the Government sold the boats and abandoned the Mississippi to nature. The trouble did not lie in any consistent opposition to Federal action. It was rather that great continuing works were undertaken by fits and starts, that appropriations for the year ahead could never be counted upon, and that promising works of improvement begun in one season were abandoned in the next. The party structure of the time may have contributed to this fitful irresolution. A part of the Whig Party was committed to Clay's American System, yet another wing of the party went much further than the Democrats in its demand for local rights. Not until the emergence of the Republican Party would a power come on the national scene capable of gathering and applying the political force necessary to a continuing program of action, and then only after the Civil War had permanently altered American ideas of the nature and powers of the Federal Government.

Engineer operations in the Gulf region during these years comprised the work carried out under the Chief of Engineers upon the Mississippi River; that of the resident military Engineers at New Orleans on the fortifications of the city; and the civil works occasionally

assigned to these same men. In addition, the Topographical Engineers — since 1831 organized as a separate bureau of the War Department — carried out important survey work, culminating in the great Delta Survey of 1850-1861, one of the most decisive events in the history of the Valley.

This schedule of Federal effort was supplemented by a determined effort on the part of the riparian states to reorganize the work of levee building on a sounder and more imaginative basis. After the great floods of 1849-1850 Congress also made an interesting though unsuccessful attempt to help the states to help themselves, as a substitute for direct Federal action. Finally, the period before the Civil War was marked by the appearance of river conventions, drawing support from a variety of interests along the river and from politicians as diverse as John C. Calhoun and Abraham Lincoln. The sum of all these efforts, Federal and state, was to demonstrate the ineffectiveness of uncoordinated local action, to give both the states and the Engineers some preliminary experience in organizing to meet the problem of the river, and to give the engineers entrusted with the survey — the civil engineer Charles Ellet and the Topographical Engineers Andrew A. Humphreys and Henry L. Abbot — the chance to draw up comprehensive plans on which Federal action in the Valley would later be based.

On the Mississippi River, the story of the snagboats is very largely that of their inventor, Captain Henry M. Shreve. Famous as the man who had adapted the steamboat to the western rivers, Shreve was appointed Superintendent of Improvements on the Mississippi and Ohio and held the post from 1826 to 1841. He designed and built the first snagboats and worked indefatigably to clear the banks of the rivers under his charge. A man of immense energy, unencumbered by "book learning" and ready to dare anything, Shreve was a good representative of his age. Finding the Red River blocked by a gigantic raft, he attacked it boldly, blocking up the little bayous by which the river had found a course around the obstacle with timber from the raft itself. With a moderate current restored to the main channel, he achieved a temporary success in breaking through to the upper Red.[34] In 1835 he founded Shreve's Landing in what was still the territory of the Caddo Indians. The town was incorporated in 1839 and chartered as the city of Shreveport in 1871.

Other efforts by the redoubtable captain were not so lucky. He tried several experiments with cutoffs, the most famous of which was across Turnbull's Bend where the Red River entered the Mississippi and the Atchafalaya left it. His purpose was to shorten the river and to avoid the shoals which had formed below the Red, but the actual effect of his work was to create a puzzle of five distinct channels — the Mississippi, the Red, the Atchafalaya, and the Upper and Lower Old Rivers, as the branches that had formed Turnbull's Bend came to be called — which plagued the Engineers until the middle of the twentieth century.[35] Moreover, "Shreve's Cut-Off," as contemporaries called it, along with the Raccourci Cutoff which the State of Louisiana had made against the advice of its own State Engineer, became the subject of studies by Ellet, Humphreys and Abbot, and many others. These studies made a general prohibition against cutoffs a part of accepted engineering lore. Not until the experiments of Brig. Gen. Harley B. Ferguson in 1932-1939 was the controlled cutoff finally shown to be feasible.[36] Shreve remains a dominating figure in the history of the Valley, but his influence was not always for the good. His bold, experimental approach led him into far-reaching errors as well as brilliant inventions and achievements.

Experiment, successful and unsuccessful, also characterized the efforts of the states to work out successful flood control policies.

Though the legislation involved is complex and often contradictory, it would appear that until about 1846 the old reliance upon riparian landholders to build and maintain the levees continued in Louisiana and Mississippi without significant change. However, this policy was becoming increasingly unrealistic as the settlement of the land behind the natural levees of the river went apace. Riparian hodlers demanded, and eventually compelled, their States to tax all in proportion to the benefits received. In Mississippi the taxation of the backlands began in 1846, though responsibility for actual levee construction remained a servitude of the riparian holders. In Louisiana, by 1856 a complex system aimed at the same end had emerged, based in part upon the new and useful concept of the levee district. A levee district might be a parish or several parishes combined; it was run by a board of commissioners who possessed the power to tax all residents of alluvial land, to let contracts, order new levees constructed, and repair the old ones. (The power to issue bonds was not granted until later in the century.) The commissioners also were empowered to call out forced drafts of slaves to combat crevasses. Establishing communal responsibility for the levees among all people directly protected by them was clearly an advance over the older nation of individual responsibility. Similarly the enactment by Louisiana of a large body of levee law implied a concern by the whole state which was also to the good. "The [levee] Commissioners," wrote the civil engineer Caleb G. Forshey, "employed engineers, enacted rules for levee dimensions, and raised this work of protection to the dignity of a profession."[37]

In 1849 and 1850 extremely severe flooding occurred, inundating New Orleans as well as the Delta farmlands. Congress, anxious to help insofar as states-rights dogma would allow, enacted the Swamp Lands Acts, which granted to the riparian states of the lower valley about 27.8 million acres of flooded lands lying within their borders. The states were to levee and drain these lands, and to pay for the work by selling the reclaimed land, which would presumably raise in value as the work progressed. The attempt to solve the flood problem by creating a sort of perpetual-motion machine, with revenue producing improvement and improvement producing revenue, ran about as well as such machines usually do. The cost of reclamation was underrated, the work itself — notably in Louisiana — grossly mismanaged, and by the mid-1850's it was evident that the scheme had failed.[38] Despite useful innovations in the riparian states, the attempt to deal with problems of continental scope by local action was not a success.

Yet the groundwork for national action was laid as a result of these same floods. In 1850 Congress appropriated $50,000 for a topographical and hydrographical survey of the river.[39] The decision to try to learn something about the Mississippi before attempting to control it was as wise as it was unusual. The Bureau of Topographical Engineers was assigned the work, and Capt. Andrew A. Humphreys and Lt. Col. Stephen H. Long undertook the survey, which was to last, with long interruptions, for 11 years.[40] At the same time Charles Ellet, a civil engineer, began a second survey under the direction of the Secretary of War. Whatever Congress had intended in ordering two simultaneous surveys, the result was not only a fresh and comprehensive look at the river, but a vigorous clash of ideas whose outcome helped to shape Federal policy for generations to come.

Ellet's study of the river was relatively brief, and his report, *The Mississippi and Ohio Rivers*[41] was published in 1853. Rather roughly handled by Humphreys and Abbot,

Ellet's work has also received discriminating praise, especially in modern times.[42] Its greatest weakness lies in its lack of extensive and precise measurement of the river's actual form and behavior — though it is only fair to add that this is a retrospective judgment, passed after Humphreys and Abbot established a whole new standard for engineers. The failings of Ellet's approach were summed up in one deadly sentence in which he wrote:

> It is not the intention here, however, to enter into a minute discussion of the uninteresting and almost useless details of the recent floods in the lower Mississippi. The great object before us — to contrive measures for the protection of the Delta from overflow — is not to be attained by a microscopic examination of such local phenomena.[43]

Humphreys and Abbot rested their conclusions upon precisely such a "microscopic examination." In consequence, even when they drew wrong conclusions, they were believed; even when Ellet drew right ones, his work remained suspect to the river's engineers.

Ellet's work also betrayed its author's hobbies and private enthusiasms, too often with an insufficiency of proof that made the book an easy target for critics. For example, *The Mississippi and Ohio Rivers* was eloquent on the possibilities of using reservoirs both to impound floodwaters and to release them at low-water stages, for the improvement of navigation. Ellet ignored — as his critics were quick to point out — the unsuitability of the flat Alluvial Valley for dams, the role of rainfall within the Valley itself in causing floods, and the critical questions of precise location, feasibility and cost in the tributary basins where dams might be appropriate.[44]

The strength of Ellet's book was intuitive, and this strength is visible mainly in retrospect. While Humphreys and Abbot committed themselves to the "levees only" thesis, Ellet viewed the levee system as no better than a necessary evil.[45] He saw the river controlled by a complex of different means, mutually supplementing one another. Levees, reservoirs, and artificial outlets, working together, could control the river, he thought; no single engineering work, by itself, could accomplish that goal. He clearly discerned the fact that the levee system would raise flood heights, and he warned gravely against optimistic efforts to gloss over a serious danger.[46] A generation that has the flood of 1927 to reflect upon can only give Charles Ellet very high marks indeed as a prophet.

Appearing some 8 years after Ellet's work, the *Physics and Hydraulics* of Humphreys and his associate, Lt. Henry L. Abbot, inevitably used the earlier work as a foil and often took the form of an adversary document.[47] In some matters, it should be noted, the two reports were in substantial agreement. Both opposed the creation of cutoffs, on the ground that they raised flood heights below the cuts while lowering those above. Both failed to see the possibility of a *temporary* outlet for the river — the modern floodway or spillway — for use only in time of great floods, the normal channel of the river being preserved at other times. But these agreements did not obscure a basic contrast in methods, conclusions, and style.

For the *Physics and Hydraulics* was strong at almost every point where Ellet was weak, and corresponding weak where he was strong. The book's claims were large, and they were made without hesitation:

> A plan of investigation was adopted far more extended than any previously attempted upon any river. . . . The operations necessary to carry out this plan, it was conceived, must furnish the mass of material essential to establish the fundamental principles of river hydraulics. . . . All knowledge requisite to accomplish the objects of the present investigation has

been secured.[48]

As in the Gospel, people listened to Humphreys and Abbot at least in part because they "spoke as one having authority."

But this authority was based upon measurements of a rigor, comprehensiveness and ingenuity that established a standard for engineers, not only in the United States but abroad. Humphreys and Abbot measured the intricate effects of the swamp-drains, and discerned the importance of rainfall in the Valley itself in causing floods. They produced a descriptive analysis of the river's bed and cross sections, of the behavior of its sediments, of the effects of crevasses, that had never been approached for thoroughness and accuracy. They tried to sum up the behavior of the river in a comprehensive equation that would provide a basic tool for the understanding of all large streams. Their work remains a monument in engineering literature, and in the efforts of Americans to understand, so that they can control, the Father of Waters.[49]

Nevertheless, it is the fate of classics not only to enlighten but to blind as well. The very mastery of the *Physics and Hydraulics* perpetuated its errors as no lesser work could have done. And those errors were often grave ones, because they affected public policy. Humphreys and Abbot "proved" that the bed of the Mississippi was not ordinary alluvium, but an "ancient blue clay" laid down in a previous geological epoch; that a "dead angle" created when the river met the Gulf, and the absence of a littoral current, would require a yearly extension of jetties there, if such should be built; and, most notorious of all, that a levee system would by itself protect the Alluvial Valley from floods. None of these descoveries were true, but their inclusion in the *Physics and Hydraulics* guaranteed their perpetuation.

Finally, the distinguished career that lay ahead of Humphreys — as a hero of Gettysburg and the Wilderness, and as Chief of Engineers after the war — would give the father of the *Physics and Hydraulics* the power, the opportunity and the temptation to try to make his work an official dogma rather than a scientific study. How he succumbed to that temptation will be recounted in the next chapter.[50]

By comparison with the great surveys of the Topographical Bureau, the early history of the Corps of Engineers in the Gulf region seems to be a record of beginnings rather than of mature achievements. Nevertheless, in the decades before the Civil War the Engineers evolved a mode of organization, built or completed fortifications that were to play a great role in the war, and made significant beginnings in several important public works near New Orleans, including the clearance of the passes of the Mississippi.

Until 1828 the Superintending Engineer for the Gulf of Mexico Frontier — Capt. (later Maj.) William H. Chase — resided at New Orleans. However, the decision in that year to fortify Pensacola caused Chase to move his headquarters to the site of the work. The corps attached great importance to the future of Pensacola, with its fine natural harbor, and Engineer officers investigated the possibility of connecting it with Mobile Bay, the Mississippi Sound, Lake Pontchartrain, and the Mississippi River by a protected waterway paralleling the coast.[51] Pensacola was viewed as the center of military activity in the Gulf, and it was from this spot that Chase exercised his general supervision of the whole "frontier" until the 1850's. Other officers destined to notable careers became part of this organization on the Gulf. Apparently no officers were permanently stationed at New Orleans between 1834 and 1839, but in March 1840 Capt. John G. Bernard arrived to superintend the construction of Fort Livingston on Grande Terre Island in

Barataria Bay. In September he received an assistant, Second Lt. Henry L. Smith, who was to serve consistently in the area until his death in 1853. A year after Bernard's assignment, First Lt. Pierre G. T. Beauregard was sent to New Orleans on temporary duty from Pensacola, where he had been Chase's assistant. This native New Orleanian apparently liked serving at home, for he contrived to remain there pretty consistently except when called away to war. In May his temporary duty ended when he was assigned to superintend Forts Pike and Wood (later called Macomb), the guardians of the Rigolets and Chef Menteur. Bernard meantime had undertaken repairs of Fort Jackson and the old French Fort St. Philip on the Mississippi River.[52]

Thus the organization of the Gulf Coast can reasonably be regarded as a prototype Engineer division, with headquarters at Pensacola, and resident officers at New Orleans and other important points. Though the "division" was at first concerned only with fortifications, its members gained experience in both field service and civil works during the decades before the Civil War.

The approach of the Mexican War brought Chase and Barnard assignment to a special Board of Engineers to "examine the Gulf Coast with reference to defense." When fighting broke out, Beauregard was sent to Tampico, while Barnard remained at New Orleans until 1847, when he was ordered to report to Capt. Robert E. Lee, the chief engineer with Winnfield Scott's army. Six months later the war was over, and Barnard and Beauregard both returned to New Orleans to resume their regular duties. Beauregard, however, won the rank of brevet major for his work in Mexico, and after some shuffling to and fro, he emerged in 1852 with responsibility for the forts formerly under Barnard's command. At about the same time he undertook, on orders from Washington, an ambitious though short-lived program of civil works as well.[53]

The Mexican War had caused a flareup in the quarrel between North and South, as the sections debated the future of slavery in the conquered territories. But in 1850 the dispute was apparently settled by compromise, and the elections of that year brought in a nationally-minded Congress. With a Whig President in the White House, a brief revival of interest in Federally-financed internal improvements took place in 1852-1853. Beauregard undertook the duties of examining a site for a proposed harbor on Lake Pontchartrain, directing the construction of New Orleans' new Custom House for the Treasury Department, and attempting to open a ship channel from the Mississippi into the Gulf. In addition, a variety of river and harbor works in Mississippi and Louisiana — and, shortly afterward, in Texas as well — were assigned to First Lt. Henry L. Smith. When Smith died of yellow fever at Madisonville during the fearful epidemic of 1853, Texas was turned over to Beaurgeard and later to his assistant Second Lt. Walter H. Stevens. These endeavors of the early 1850's were a preview of future duties of the New Orleans Engineer Office.[54]

At the time, however, they were premature. The period of civil works activities under Millard Fillmore was short-lived, like his Presidency. In 1853, Franklin Pierce, a strict constructionist with a cabinet dominated by extreme states-rights advocates, came to power. Not only did appropriations for civil works almost cease by 1854, but well-established policies for the improvement of navigation were abandoned. Pierce vetoed the congressional appropriation for snagboats, and his secretary of war — Jefferson Davis, the future president of the Confederacy — sold the boats in 1855 for about one-fifth of their cost to the firm of Eads and Nelson, of St. Louis. James Eads, the future builder of the Mississippi jetties, and his

partner then offered to contract with the Government for the clearance of the Mississippi, Missouri, Ohio, and Arkansas Rivers, guaranteeing as a condition of payment that the number of steamboat wrecks caused by snags would be reduced by 30 percent within 5 years.[55] The proposal passed the House but died in the Senate. The results were disastrous. In their last working year, ending 30 June 1854, the boats removed over 56,000 obstructions from the river. When operations were resumed a decade later the Mississippi was found to be a maze of snags, wrecks, and wartime casualties of the fighting that marked the passage of Farragut and Grant. The Federal Government then had the job of replacing the boats at greatly inflated postwar prices. The Pierce veto was a triumph of short-sighted policy.[56]

But by the mid-1850's all national concerns were being pushed aside by the renewal of sectional conflict that followed the Kansas-Nebraska Act of 1854. As if to signal the end of an era, Maj. William Chase, the pillar of the Engineers in the Gulf region since the 1820's, was reassigned in 1856, and resigned from the Corps in October of the same year. An Engineer Order of 9 April 1857 created a Board of Engineers for the Gulf Coast, of which Beauregard was ranking member, the others being First Lt. Stevens (New Orleans and Galveston), Capt. John Newton (Escambia Country — that is, Pensacola — Florida), and Capt. D. Leadbetter (Mobile). This organization was evidently created to fill the vacancy caused by Chase's departure, and the organization of the Crops in the region remained in approximately this form until the eve of the Civil War. In November 1860 Beauregard was appointed superintendent of West Point, and on 5 January 1861 was relieved of his duties at New Orleans by Bvt. Second Lt. W. H. McFarland. Within a week the works near New Orleans were "wrested from the U.S. by insurgents." Beauregard returned to New Orleans on 25 January and resigned his commission effective 20 February 1861. First Lt. Stevens followed his example.[57]

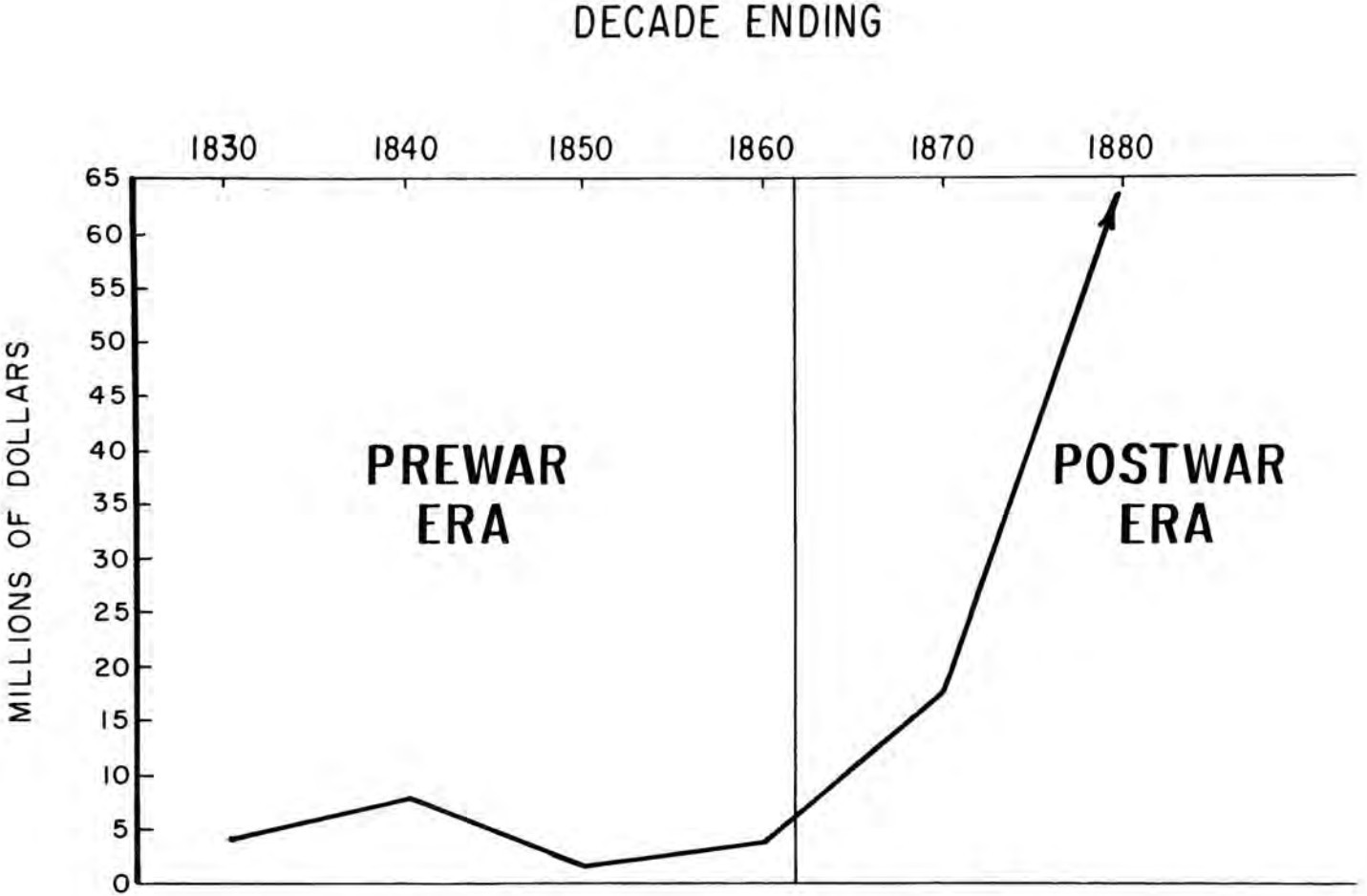
Already old comrades were taking up arms against each other. In April it fell to Beauregard, as a Confederate officer, to direct the bombardment of Fort Sumter. The war that was to end the age of localism had begun.

Probably the decade of the 1860's was the worst that the Delta has ever had to endure. As everywhere in the South, the war meant great loss of life and uprooting of population; it meant also the revolutionary destruction of black slavery, the overthrow of the old ruling class, and the beginning of a troubled journey into a new kind of society. For the Delta, the decade was also one of recurring natural disasters. The ruin caused by the great flood of 1858 had not been repaired when war broke out, and new floods followed in 1862, 1865, and 1867, any one of which would have been a serious calamity in time of peace. The return of peace found the people of the Mississippi flood plain in a truly desperate situation, impoverished yet obliged to undertake the costly job of restoring the levees before the recovery of agriculture — on which everything else depended — could begin.[1] It was ironic that the Delta ultimately found salvation at the hands of the very agency that had played so large a part in destroying it — the Federal Government.

The reconstruction of the Mississippi Valley meant two things: reopening the channel of the river to navigation, and preventing the recurrent floods that devastated the land along the river. In some ways these problems were intimately related, in some ways quite different. To New Orleans, the reopening of the river and the clearing of the Passes meant economic revival for a city whose life depended upon trade. For the farmers of the Northwest, a reopened river meant the opportunity to force lower rates upon the railroad trunk lines by the pressure of cheap waterborne transportation. For the people who lived in the flood plain, the emphasis was quite different: transportation was important, but flood control was literally a matter of life or death. The northern business interests that invaded the South in the wake of the armies had their own concerns. Buying into commercial real estate and the rich agricultural lands, eastern capital acquired a growing practical interest in the progress of flood control — an interest which became even greater as the railroads built their vulnerable rights-of-way across the flood plain. The political and economic tributaries of the Mississippi ramified even farther than its tributary streams. The New York Chamber of Commerce, Gould's railroad empire, the Granges of Illinois and Wisconsin, the cotton and sugar growers of the flood plain, and the commercial houses of New Orleans all had their own special needs. All applied pressure to the Federal Government to secure the kind of action that would favor themselves.[2]

And that Government had been transformed drastically and permanently by the Civil War. The American people had been given a whole new concept of what powers Washington could wield, and how much it could spend without endangering the economy.[3] While constitutional questions would continue to be raised for decades to come about the right of the Federal Government to deal with the problems of the river — especially with the question of flood control — these arguments would take place against a new factual background. The war, which had wrecked the Delta, brought with it a triumphant demonstration of the ideas of Hamilton and Clay, and so made possible for the first time a comprehensive national policy for the national problem of the river.

But the distance between possibility and action in politics is rarely measured along a straight line. Washington began by moving along familiar grooves — surveying the problem, making reports that brought no action, and actually embarking only on programs that had been under Federal control before the war. Then, gradually, and by ways no one



FEDERAL APPROPRIATIONS

FOR WATERWAYS DEVELOPMENT

Based on Chorpening, "Waterway Growth In the U.S." p. 1001.

could have foreseen, it moved toward a comprehensive program of channel maintenance and flood control. Old habits died hard, and 14 years elapsed between the war's end and the first really decisive break with the past.

Beauregard's resignation from the Corps in 1861 and that of First Lt. Henry L. Smith the following month left no Army Engineers in the Gulf region, except one at Key West and one at Fort Pickens in Pensacola Harbor.[4] From this low point the number of Corps personnel began to rise as New Orleans became the objective of Federal strategy aimed at conquering the Mississippi Valley and cutting the Confederacy off from its western supply bases. A Department of the Gulf was created under Maj. Gen. Benjamin Butler.[5] Godfrey Weitzel, a lieutenant whose political connections were shortly to bring him an appointment as brigadier general of volunteers, became the first Chief Engineer of the new department.[6] After the rapid conquest of New Orleans in April the Federal army headquarters there became his duty station. At the end of 1862 Maj. D. C. Houston replaced Weitzel, but the following month responsibility for the permanent fortifications of New Orleans was turned over to Capt. John C. Palfrey, who commanded at Ship Island. In November 1863 his duty station became New Orleans and in March 1864 the forts at Pensacola were added to his command.[7] Thus two distinct commands emerged, one attached to the army and serving its needs, the other concerned with the immobile fortifications of the region. From the latter evolved the Engineer District of postwar days.

In June 1865 Maj. Miles D. McAlester became Chief Engineer of the Department of the Gulf just in time to see that war-born department pass out of existence. For a time he bore the title "Chief Engineer of the Department of Louisiana," while another officer[8] took over the duties of Maj. Gen. Philip Sheridan's army of occupation. In December 1865 the defenses of New Orleans and Ship Island were given to McAlester, and by March 1866 he was described as being in charge of "Engineer operations on the Gulf of Mexico." By a curious game of musical chairs McAlester had now moved into a position closely resembling Maj. Chase's old command. In his new role McAlester soon began to undertake civil works very similar to those of prewar days. An Engineer Letter of July 1866 charged him with "improvements of mouth of Mississippi River," and by January 1867 he was experimenting with the first of his ill-starred dredging attempts at Southwest Pass. His report from New Orleans of 29 March 1867 bears the heading "United States Engineer Office," and with the adoption of this title the evolution back to a peacetime resident Engineer may be considered complete.[9]

The continuity with prewar days is plain to see. Yet the changes wrought by the war made possible a continuous expansion of civil duties that contrasts strongly with the tentative and sporadic efforts of earlier times. Within a decade the Engineer District of New Orleans would bear responsibility for a remarkable melange of such works, including the maintenance and improvement of New Orleans and Galveston harbors, surveying for an Intracostal Waterway, and improving a host of minor harbors, rivers and streams stretching from the Pearl River to the Rio Grande.[10]

But the first area in which the Federal Government felt obliged to take action after the war was in the opening of the Mississippi. The mouth of the river became the special problem of the New Orleans Engineer Office. In struggling with this problem McAlester, and his successor Maj. Charles W. Howell, found themselves at a critical point in the evolution of the Corps and of the responsibilities of the Federal Government.

Navigation was the first problem. The

Mississippi River at war's end was in an appalling state. The snagboats had not operated since 1854, and dozens of wrecks, including some left by the war, encumbered the channel. The caving of forested banks had added the usual quota of "planters" and "sawyers" to the stream. Urged on by many pressures — a memorial sent to Congress in 1866 by the politically potent Union Merchants' Exchange of St. Louis might be taken as an example[11] — the Federal Government began to move into an area where its authority was traditional, and political pressures made action necessary.

By mid-1867 the Engineers had established an Office of Western River Improvements, and under Col. John N. Macomb the rebuilding of the snagboats began.[12] To deal with the wrecks, the skills of war were applied and "submarine armor, diving-bells, and electro-magnetic batteries for exploding torpedoes" were added to the more conventional fittings. After more than 10 years the Federal Government was back in the business of channel clearance, this time for good. But clearing away snags and wrecks was only a beginning.

Farmer agitation against the rates charged by the railroad trunk lines grew rapidly in the years following the Civil War. The attractions of the Mississippi as an alternative route to market — cheap, well adapted to the transport of bulk goods, a water highway "free for every man to run his boat and where no corporation should own the track"[13] — were very great, as a succession of river improvement conventions made plain. But if the river was to become once again a main road of commerce, the port of New Orleans must be made a satisfactory point for the transshipment of goods. This meant clearing the Passes of the Mississippi of the bars which obstructed the increasingly heavy trading vessels that plied the deep sea. Ultimately, an all-year channel from the Lakes to the Gulf would have to be opened, guaranteeing the movement of goods at low water as well as high. In time the Engineers would be called upon to carry out most of this far-reaching program, but the way to its achievement was tortuous and slow.

Clearly the all-year channel was a project demanding immense efforts and great expenditures, and not until 1907, when the railroads had all but destroyed the commerce of the river, was the goal achieved. The clearing of the Passes was another matter. All the commercial and farming interests of the Mississippi Valley wanted this improvement, and opening the Passes, plus the work of the snagboats, represented the least action that Congress felt it could safely take to free the Mississippi for navigation. In March 1867 Congress authorized the Secretary of War to build and operate two stream dredgeboats to open navigable channels through the bars of the Mississippi.[14] In June, as we have seen, the Secretary of War passed on the job to the New Orleans Engineer Office.

After the duties of war and the confused transition to peace, the resident Engineer at New Orleans had received an old assignment, backed by a new urgency. But the problem of the Passes was to develop so strangely, and take so many unexpected turns, that it must be treated at considerable length.

At each of its mouths the Mississippi, like other silt-bearing streams, loses velocity as it meets the waters of the sea and drops its burden of silt and the "bedload" of heavy sand and sediment that is pushed along the bottom of the river. These sediments pile up, forming a bar which gradually obstructs the river mouth. At the crests of its bars, the Mississippi oftentimes ran only 8 to 12 feet deep in the major passes. By the late 1860's, it was not uncommon for oceangoing ships to require 26 to 28 feet of water, and the post of New Orleans was becoming more and more

isolated from the most profitable forms of commerce. Before the war a variety of palliatives had been tried. Ships would wait on high water (sometimes for months) and inch themselves over the bars by the use of anchor and capstan, or the thriving towboat companies of New Orleans would provide haulage at exorbitant fees. The need had been recognized long before the Civil War, but the record of attempts to achieve a permanent channel was discouraging.

Basically only three methods had ever been proposed for dealing with the bars: harrowing, dredging, and the use of jetties. All of these methods were the subject of worldwide attention among hydraulic engineers, since the Rhone, the Danube, and the Vistula, among other streams, had problems similar to the Mississippi. What distinguished the Mississippi was the vastness of the river — fourth largest in the world — and the fact that it discharged into the sheltered Gulf of Mexico, where tidal action was weak.[15] In addition, the Mississippi was exposed to tropical hurricanes during half the year, which meant that any solution to the problem of the Passes had to be one that the next great storm would not destroy. No more preplexing problem could have been presented to the engineers of the nineteenth century than this, and careers were made and wrecked on the shoals of South and Southwest Passes and Pass a Loutre.[16]

The first recorded attempt to deal with the bars took place in 1726 when the French attempted to loosen the bar at Southwest Pass by dragging an iron harrow across it.[17] In the next century and a half, a number of devices were tried: a bucket drag in 1837; harrowing again at Southwest Pass, which opened a temporary channel in 1852; frail jetties of board and pilings in 1857; and a final try at "stirring up" between January and August 1860.[18] Successes were temporary at best. Harrowing, and its more sophisticated version of dredging, simply did not get at the problem of the river mouths.

The trouble was that after leaving its banks the river — though it continued to exist, a plainly discernible stream of fresh water flowing through the brine — lost most of its velocity, and hence most of its carrying power. The temporary success achieved by "stirring up" the bar lasted until the first strong wind came off the Gulf. A single storm-tide piled up the dispersed sediments again, undoing months of hard labor in a single day. The river simply lacked the power to carry the bar materials into sufficiently deep water. A solution could only be reached if the velocity of the river was increased by artifical extensions of its banks: in other words, by jetties.

Yet the experiment with privately constructed jetties in 1857 had failed too. In retrospect it seems clear that the reasons were not essential — that bad engineering and insufficient appropriations were at fault — while the difficulties with harrowing were basic. None of this, of course, was apparent to the people of the time. They knøw only that they faced a problem which apparently would not yield to any method that they tried. Nevertheless the approach by harrowing or "stirring" the bar had acquired the curious hypnotic power possessed by errors that have long been persevered in. Also the alternatives were reckoned prohibitively expensive. Therefore the Engineers gave the old method one last, most imaginative and expensive trial: they built the *Essayons*.

A requirement that McAlester improve the mouths of the river was included in a bill of 23 June 1866.[19] An Engineer Order in July specified the use of a private contractor, and McAlester engaged Horace Tyler, who had an imaginative new idea to offer.[20] Tyler adapted a "double-ender" steamboat with conical four-bladed screw propellers projecting below the keel, and an auxiliary harrow at each end of the boat. Functioning

as drills, the screws proved capable of tearing up the bar material. But the adapted steamboat was a jerrybuilt affair which suffered many breakdowns, while Tyler offered McAlester incerasingly imaginative excuses. Finally in May 1867 the contract was cancelled, when it appeared that the contractor was "likely to accomplish no results."

Meantime, in March 1867, Congress had authorized the Secretary of War to build and operate two stream dredgeboats on the Mississippi. McAlester now submitted plans and specifications for building an elaborate improvement upon the principle of Tyler's dredge. Sixteen-foot screw propellers at each end of the boat and iron scrapers were to do the work of harrowing the bar. His plans were approved in June, and a Boston firm entered the low bid of $223,000 for the work. By October McAlester was in New York "perfecting plans, etc. — for Stream Dredge for Mouth of Mississippi River." His assistant Lt. David Payne went to Boston to oversee the work, which was long and difficult.[21] Not until July 1868 did the *Essayons* undertake the sea voyage to New Orleans, where she arrived without serious accident.[22] By October marked success was being claimed for the new craft, which was gnawing at the bar of Pass a Loutre.[23] Yet within a few years disillusionment had set in, and the whole question of the Passes had to be reopened. What had gone wrong with the *Essayons*?

> She was commanded [stated a report of the New Orleans Engineer] by competent and disinterested officers of the Federal Navy. These men performed their duty faithfully. The dredge-boat was repaired and altered without regard to expense, and the experiment of dredging has been conclusively made. It has failed to maintain permanently a much greater depth of water than that which nature has prescribed as the regimen depth on the bar. Dredging has, therefore, proved a failure. To deepen the bar at the season when there is little current is not very difficult. [But] the whole labors of a season have been, and may be again, destroyed in a night.[24]

It was against the background of this expensive failure that McAlester's successor, Brevet Maj. Charles W. Howell, was instructed in 1871 to make surveys and estimates for a ship-canal to connect the Mississippi River with the Gulf of Mexico.[25]

This idea went back at least to 1837, when Maj. William Chase explored the possibility in a report to the Chief of Engineers. Chase favored the idea, but no action was taken to implement it.[26] In 1852 an act had appropriated $75,000 for "opening a ship channel" between the Mississippi and the Gulf, and a board of one Naval and three Engineer officers convened to decide how the appropriation should be spent.[27] Beauregard was a member of that board, which concluded that the limited funds available made impractical any course other than stirring up the bar at Southwest Pass. But in its report, the Board went on to discuss four methods of opening the Passes, in increasing order of difficulty and expense: stirring up, stirring up assisted by dredging, contraction of the river by jetties, and closing the useless passes.[28] If all else failed, they recommended consideration for a ship canal as a "plan to fall back upon." Howell took the position that all else *had* failed, and that, expensive as it was, the ship canal could be justified by its benefits to navigation. Following ideas first suggested by Maj. Chase, Howell recommended in 1874 that the canal be built near Fort St. Philip, where the river was separated from the Gulf only by a narrow strip of marshy land. The canal was to be protected by a lock, and would open into Breton Sound, where adequate depths of 30 to 40 feet were to be found on a stable bottom of firm clay.[29] Above all, such a canal would provide a

permanent solution to the recurrent problem of the Passes.

In taking this position, Howell could count on strong backing. The prestige of ship canals was high since the completion of Suez in 1869. The most famous military engineer in the New Orleans area was P. G. T. Beauregard, and Beauregard had come to favor the canal. The business community of New Orleans had inspired the original investigation by Chase, and remained firmly wedded to the idea in the 1870's. Finally, the idea was embraced by Andrew Atkinson Humphreys, and Humphreys was not only *the* expert on the river: after July 1866 he was also Chief of Engineers.[30]

Yet there was opposition from the start. Howell's estimate of the cost of a canal was $7.4 million, and he admitted that this did not include "amounts required for engineering, superintendance, and contingencies" — a considerable omission. A later estimate by Humphreys raised the cost to $13 million. Perhaps a solid front in the Corps of Engineers might have succeeded in putting over the canal, but the Corps itself was divided. In June 1873 an Engineer Board met at Washington to consider the canal and approved it with one significant abstention: Col. J. G. Barnard, the President of the Board, who had once shared the responsibilities at New Orleans with Beauregard, entered a minority report. He declared that considerations of defense and the possibility of storm damage to ships waiting in Breton Sound made the canal a dubious idea. Instead he suggested that thought be given to a jetty system. Prophetically, he rejected Southwest Pass and Pass a Loutre as the proper site for jetties, and pointed instead to South Pass: narrow, relatively straight, yet entirely adequate, when cleared, for the passage of large ships.[31] Doubts caused by the high cost of the canal — and it should be remembered that a severe depression had struck the country in 1873 — were reinforced by this division in opinion among the Engineers as Congress began to consider an alternative proposal put forward by James B. Eads of St. Louis.[32]

Eads had already won considerable fame as a shipbuilder for the Federal Navy during the Civil War, and as an able engineer both before and after it. He had salvaged wrecks in the Mississippi, using a diving bell of his own invention, and had built the great three-arched steel bridge across the river at St. Louis. He was gifted in a variety of ways: an excellent engineer, he was also an organizer, at home in office or field, and able to rule a mob of immigrant laborers or confront a congressional committee with equal aplomb. He knew how to get the backing of moneyed men, and he had a gift for self-advertisement, a flair for propaganda. In many ways he resembled his Robber Baron contemporaries, but without their dishonesty and technical ignorance. He was no mean opponent, as the Chief of Engineers was to discover.[33]

According to his own statement, Eads had urged the jetty plan upon a group of Congressmen visiting the mouth of the river in May 1873.[34] Shortly before the end of the year he made a formal proposal to open Southwest Pass by means of jetties for a payment of $10 million. Debate began in Congress, and at first the proponents of the canal prevailed. In June 1874 the House appropriated $8 million to begin construction of the canal, but a Senate committee rejected the bill. In view of the conflict over the two plans, Congress then set up a mixed board of experts and, in an interesting anticipation of the later makeup of the Mississippi River Commission, ordered it to be composed of three Army Engineers, three civilians, and one member of the Coast and Geodetic Survey. Its report, in January 1875, emphasized the division within the Corps as two Engineers — Brig. Gen. Cyrus B. Comstock and Brig. Gen.

B. S. Alexander — voted with the three civilians and the Coast Survey officer to approve the jetties and to recommend South Pass for the experiment.[35] The House, more sensitive to political pressures in the West, and apparently ready to approve any plan that gave a promise of working, promptly voted $8 million to be paid Eads for opening Southwest Pass, with an annual maintenance grant of $150,000. During debate the Corps was both attacked and defended, but probably Congressman Stanard, who reported the bill, gave the best statement of why Congress accepted Eads' proposition: the Engineers had so far failed, the Treasury was in no good state, and Eads offered to get results first and charge the Government later.[36]

The Senate drove a harder bargain. First it insisted on South Pass instead of Southwest. Barnard had already recommended this pass for engineering reasons, but probably the Senate was influenced more by the fact that the pass was entirely worthless as it stood, with only 8 feet of water over the bar. Construction work would not obstruct navigation, and, if Eads failed, he would leave things no worse than they had been before.[37] The Senate also determined to pay Eads only $5.25 million for his work, in a series of payments to be made as successively deeper and wider channels were attained. (Maintenance and interest on retainage, however, raised the total to $8 million over the 20 years that the contract would run.) Eads was to get his own backing and was to be paid nothing until the specified channels had been achieved and certified by officers of the Corps of Engineers.[38] The job of checking Eads' work was given, not to Howell at New Orleans, but to Brig. Gen. Cyrus B. Comstock, who had voted for the jetties on the Board of 1874.[39] After Eads had established his base of operations, First Lt. Charles E. B. Davis was sent there to check his work. In 1876 Capt. Micah Brown took over his duties. Under this setup, James Buchanan Eads began the work of giving New Orleans a permanent passage to the sea.

Eads' struggle proceeded on three levels simultaneously. He began by building Port Eads on the bank of South Pass and running a telegraph line to New Olreans. At Port Eads material was accumulated and the workmen, supervising engineers, and the Army Engineer officer assigned to observe the work had their quarters. Port Eads was not a place of Parisian glamor or even of minimal comfort and at least once during the course of work it was devastated by a yellow fever epidemic.[40] Nevertheless, on 14 June 1875 work got underway on the alteration of South Pass.

This involved two separate operations, one at the mouth of the Pass where the jetties were being built, and one at the Head of Passes, where South Pass was further obstructed by a shoal. The accompanying illustration will show better than words the means by which the jetties were constructed: to a line of pilings willow mattresses were attached and sunk. On this foundation alternate layers of broken stone and fresh mattresses were laid. When the surface had been reached, a railroad line was run out on piers laid over the jetties and concrete poured from dump cars into wooden molds. The East Jetty proceeded directly out from East Point, the extremity of the land; the West Jetty, since it stood within the old mouth of the Pass, was connected to the west bank by a structure known as Kipp Dam. Within the Pass were wing dams to increase scour, and at the Head of Passes, structures described as "T-dams" redirected the flow of water to scour away the shoal. Additionally, sill dams were constructed across Southwest Pass and Pass a Loutre to reduce slightly the flow of water into the main passes and force it through South Pass.[41]

Eads' second struggle consisted of the effort to get money. Congress was slow to

SECTION ON A EAST JETTY

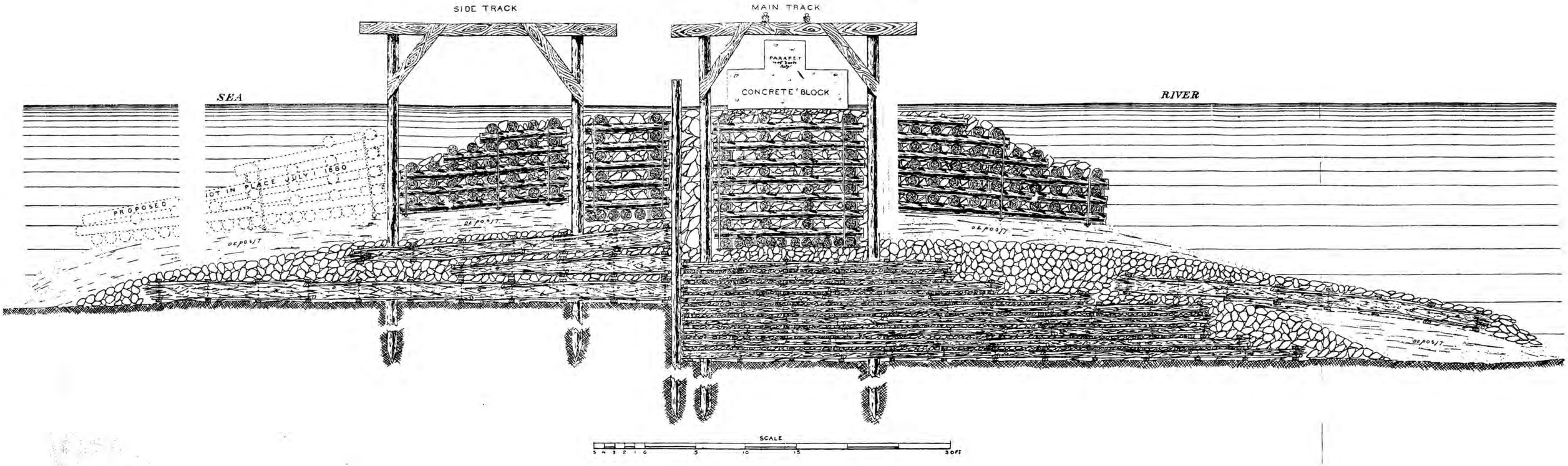


CHART Nº 5

TO ACCOMPANY THE

ANNUAL REPORT

UPON THE

IMPROVEMENT OF SOUTH PASS

OF THE

MISSISSIPPI RIVER,

BY

C. DONOVAN, Ass't, Eng'r.

COMPARATIVE SECTIONS

OF THE

MISSISSIPPI RIVER,

ON

LINES GH and IJ

CHART Nº 4,

From Coast Survey soundings June 1875 and soundings made June 1880.

pay, and the Engineers were in no hurry to certify that the necessary depths had been achieved. Large debts had to be incurred, and excursions were instituted for visiting capitalists to enable them to examine the works for themselves.[42] Every effort was made to paint the most encouraging picture of the jetties' progress, and every possible pressure was brought to bear on a reluctant Congress to secure easier terms than the bill of 1875 allowed. Eads claimed that the channel prescribed for the final payment, 30 by 350 feet, was simply too large for South Pass to bear, and he lobbied vigorously for alterations in the bill, getting one change in 1878 and another in 1879.[43] Thus the financial and political war went on beside the engineering work.

Intimately involved with the success of this fight was Eads' third battle — his fight with the Corps of Engineers. Eads portrayed himself as a David fighting the Goliath of the Corps, a picture which contained both truth and falsehood. It was unlucky for the Corps that the Chief of Engineers and the local Engineer officer at New Orleans made Eads' self-dramatization seem truer than it was. In fact, the jetties received support at critical moments from Engineer officers like Barnard, Comstock, Alexander, and Micah Brown, without which they could hardly have been built at all.[44]

But Humphreys' opposition is historical fact. In a way his feelings are easy to understand. The Corps was his life, and giving Eads such an important work as the opening of the Passes struck him as being an attack on the Corps — a belief which the remarks of some members of Congress may have encouraged.[45] Moreover, Humphreys had become a captive of his own classic, a theologian defending his own Holy Writ. The *Physics and Hydraulics* said that a new bar would form in advance of the jetties; since the new bar must form, the jetties would have to be advanced year by year. Humphreys even claimed to know just how far — 1,200 feet.[46] As the jetties began to succeed, and as the reports of his own officers piled up, showing that the bar was not re-forming, Humphreys in no way changed his position; his arguments only became more labored and more unreal. He seemed to feel that anybody who supported the jetties was impugning his own status as the final authority on all aspects of the Mississippi River. In taking this line, he increasingly set himself in opposition to the national policy as established by Congress.

Howell seconded his chief's hostility. He took surveys which showed — surprisingly, in view of what was actually happening[47] — that the Gulf just beyond South Pass was shoaling as Humphreys had said it would. He then leaked the results of his surveys to potential investors in the jetties and to the New Orleans newspapers, which, in the usual fashion, printed them as coming from a reliable source.[48] The surveys of Capt. Micah Brown were sent through official channels, eventually winding up in the hands of Humphreys. These reports were not tampered with in any way, but Eads was not able to see them until they had been printed in the report of the Secretary of War, by which time, of course, they were out of date. The officers he approached for the results of the official surveys replied that their reports could only be shown to their superiors.[49] Meantime Howell made his opposition public. "I know," he wrote in an open letter to two New Orleans newspapers, "that . . . . seaward of the outer end of [Eads'] jetties the Gulf has shoaled at a rate which, if continued, will in eighteen high-water seasons bring the Gulf bottom to the surface, and necessitate the prolongation of the jetties at least seven and a half miles."[50] Signed with his name and official title, such a judgment was damaging indeed.

Eads, however, was a vigorous partisan as

well as an engineer, and he had potent backers who were not at all inclined to lose their money. An open letter to the Secretary of War[51] brought an order to Comstock to allow Eads access to the surveys. As the facts of the surveys came to light, they gained added weight from the accurate and extensive nature of the work that Capt. Micah Brown was doing at Port Eads. He found a channel forming which, despite many changes in the alluvial bottom, was clearly growing wider and deeper. Brown painstakingly measured the depth of the sea on radial lines fanning out from the jetties, and sent to the Secretary of War charts which proved conclusively that no new bar was forming.[52] Running between its artificial banks of piling and willow mattresses, crushed stone, and poured concrete, the Mississippi was quite capable of hurling its sediment down the continental slope into water so deep that Eads' estimate of two generations for the lifespan of his jetties was, if anything, too brief. By 1877 oceangoing ships of the largest size were entering the Mississippi by the smallest of the major passes.[53] For people and Congress alike, that settled it.

But not for Humphreys. His last fight was against the creation of the Mississippi River Commission, in which he evidently saw a plot to advance the fortunes of Eads.[54] On 22 June 1879 the bill creating the Mississippi River Commission was approved. It was widely understood that President Hayes would appoint Eads one of the civilian members. Eight days later Humphreys retired from the Corps of Engineers. He was 69 years old and covered with well-deserved honors, and it was tragic that his last years of power were embittered by a controversy in which he showed the worst, instead of the magnificent best, of himself.

The triumph of the jetties played an important role in the creation of the Mississippi River Commission that followed. Congress had dared to ignore established precedents, had brought the country's growing body of skilled civilian engineers into the building of a great public work, and had been justified by the results. With one success to its credit, Congress was more ready to listen to those who claimed that, for political, economic, and humanitarian reasons, it was time to adopt a comprehensive national policy for the protection and development of the Mississippi Valley. This would mean coming to grips with the intertwined problems of navigation and flood control, and the Constitutional limitations which appared to allow the Federal Government to act on the former but not the latter. It was high time that the effort was undertaken, for the record of floods in the Mississippi Valley since the Civil War was a grim one.

The postwar Federal Government had begun to interest itself in the flood problem as early as December 1865 when Secretary of War Edwin M. Stanton ordered Humphreys to make a tour of inspection of the ruined levee system. Humphreys' report was gloomy. In the Delta alone he counted 59 crevasses, at least one of which was 2 miles long and flooded thousands of fertile acres at every rise in the river. A million and a half cubic yards of earth, Humphreys estimated, would be necessary to fill the gaps, let alone bring the levees up to necessary grade. Humphreys' report, however, was chiefly notable for his frank statement that the Federal Government — "some authority entirely beyond the influence of local interests," as he expressed it[55] — must intervene to build the great mainline levees which he considered necessary if the Valley were ever to realize its potential as a producer of agricultural wealth.

But the Government, though ready in 1865 to take surveys, was far from being ready to take action. Humphreys' report was printed by the Senate, but nothing else was done. In

early 1869, Abbot reported on progress since the Humphreys survey, and found the picture still discouraging. He noted that "the State of Louisiana alone seems to have made a determined effort to close the breaks in the levees," but that, despite an expenditure of $2.7 million, "the early flood of 1867 caused immense destruction throughout the State."[56] The depression of 1873, followed immediately by the disastrous flood of 1874, capped the misery of the Valley. Alarmed at reports from the impoverished, flooded districts, Congress created yet another mixed board, generally called the Levee Commission, which was to "investigate and report a permanent plan for the reclamation of the alluvial basin of the Mississippi River subject to inundation."[57]

The Levee Commission's report was impressive both for its analysis of what was wrong and for its recommendations on what was to be done. The Commission found 143.4 miles of crevasses south of Commerce, Missouri. It found the local levee boards desperately poor, without credit, and often incompetent in their methods of building levees. As a result of inadequate heights and erosion of the river's banks, 107.5 miles of levee had been destroyed in Louisiana alone since the end of the Civil War. Comprehensive reforms in construction methods, height and standard grade were needed. Above all the localism of the flood control system must be ended. "The army of defense," wrote the Commission, "has been content to remain a simple aggregation of independent companies, with here and there a battalion under the command of a board of officers. That victory has not more frequently perched upon their banners is surely not surprising."[58]

The recommendations of the Levee Commission were precise, and revolutionary. Each of the six great drainage basins from Cape Girardeau to the sea should have "a chief engineer, armed with ample powers." These should include plentiful funds, the right of eminent domain in obtaining rights-of-way, and the power to draft, in times of emergency, every able-bodied man within "a reasonable distance" of the levee for labor thereon. Over these engineers a "general board of commissioners composed of a president and the several district chiefs" should exist, with a permanent organization and stated times of meeting. This board should have no superior but "the supreme authority from which it derives its legal existence . . . ." Whether this should be the Federal Government or some mutual compact of the riparian states, the Levee Commission did not presume to say.[59]

Naturally such a plan was, to put it mildly, politically premature and was never acted upon. Yet as a sign of the times it was by no means unique. In the decade following 1874,[60] three major river conventions met demanding unified political action among all the people of the Valley.[61] Eads built his jetties to the accompaniment of nationwide publicity, and a spate of books appeared, ranging from the 1876 reissue of the *Physics and Hydraulics* to Mark Twain's three classics, *Tom Sawyer*, *Huckleberry Finn*, and *Life on the Mississippi*.[62] The public seemed ready to absorb everything about the river, from its hydraulics to its mythology. Against this background of changing public and professional opinion Congress began the serious work of developing a national policy for the river.

The plan which gained most backing among advocates of flood control and navigation alike was for the creation of a permanent body, organized along the lines of the mixed commissions of 1874 and 1878, and having rather ill-defined powers to deal with the river. The lack of precise definition was essential to avoid the constitutional restrictions on Federal action, and also to avoid collision between the advocates of navigation

and those of flood control. Representatives of the Valley and their allies were quite willing to have the ultimate role of the Commission decided by the Commission itself, and by the course of events.

The House of Representatives, as usual, took the lead, and produced a bill creating a five-man Commission. Three members were to be Army Engineers, two were to be civilians, and the president was to be chosen from the military.[63] The alternative plan for a seven-man Commission, with only three Army Engineers, three civilians, and one member from the Coast and Geodetic Survey, was worked out by the Senate Select Committee on the Improvement of the Mississippi River and its Tributaries. Senator McMillan, in debate, put his finger on the conflict underlying these changes when he said:

> It is not to be concealed here that this [Senate version] is a part of the extension of the improvement by jetties at the mouth of the river, and this plan is but a continuation of those jetties. Now, while I concede the engineering ability of Mr. Eads I do not believe that the survey authorized by this bill should be under the control of influences outside the Engineer Corps of the Army . . . .[64]

Under the leadership of Senator Lucius Q. C. Lamar of Mississippi, however, the Committee's bill prevailed. Attempts by the Corps' friends to restore the House version and efforts by Eads' supporters to allow President Hayes to choose the Commission's president from the civilian members were both defeated by large margins, and the final version, in which the House acquiesced, was in essence the compromise measure that Lamar wanted.[65] He took the pragmatic view that, since the Army Engineers would do most of the practical work of the Commission, its president had better be chosen from among them.

With the creation of the Mississippi River Commission the Federal commitment to solve the problems of the river began. The act creating the Commission was the egg from which a new era would hatch, both for the people of the Valley and for the Corps. The possibility that this might be so was clearly understood both by the proponents and the enemies of the new organization. The ill-defined powers of the Commission[66] suggest that the men who created it deliberately framed the law in such a fashion that its constitutionality would be difficult to challenge, while the way was left open for the Commission, once in business, to enter the field of flood control.[67] The New Orleans District had been the site of many of the events which shaped the great change in national policy. The new policy was now, in its turn, to reshape the nature and duties of the District, to say nothing of reshaping human life throughout the Alluvial Valley as well.

The development of the Mississippi River Commission is primarily the story of its growing preoccupation with the levee system, a preoccupation that eventually brought it into grave difficulties. The evolution of the "levees only" policy is complex in detail, but easily comprehensible in terms of the physical and political facts of life in the Mississippi flood plain.

The first question to be faced by the new-fledged Commission was what precisely its own functions were to be. Certainly the organic law had not defined them with any degree of distinctness. In the process of definition the military members took an important hand, usually interpreting as generously as possible the authority assigned the Commission by Congress.[1] Their aim — on which they were usually joined by the civilian members — was to start building levees as quickly as possible. No member consistently opposed this aim except Brig. Gen. Cyrus Comstock. James Eads and Benjamin Harrison (the future President of the United States) both wanted to get into levee building, though both refused to subscribe to the efforts of the commission's majority to do so by proving that levees were essential to navigation.[2]

Yet several years of uncertainty preceded the entry of the Commission into flood control. Its only unquestioned duty was to take over the surveys for improving the low-water navigation of the river which had formerly been carried out by an Engineer board.[3] Following the provisions of the organic law, it maintained until 1896 a program of channel improvement by means of "permeable contraction works" — in effect, an application of the jetty principle to the river itself rather than the Passes.[4] Beyond these duties the Commission felt considerable uncertainty about its future, about its duties, and about the way it would function. It did not want to be an executive body, yet it was obliged to take care of details of the maintenance and construction of certain works.[5] As late as 1881 it was looking to the year ahead as a time of experimental work connected with the contraction of the river. Apparently none of its members expected to be building levees anytime soon.[6]

The flood of 1882, which overwhelmed the partly restored levee line — and, very often, the remaining credit of the levee districts as well — changed this picture entirely. A drastic shift in policy and organization followed. Congress gave the cue when it passed the River and Harbor Act of 2 August 1882. "By the decision of the honorable the Secretary of War," the Commission was relieved of direct responsibility for carrying on its works of construction. At the Commission's suggestion, the river below Cairo was divided into four administrative districts, each in the charge of an officer of the Army Engineers, under whose direction all work for improving the river was to be carried on.[7] In time these district Engineers would be directed to meet as a board to recommend the distribution of Commission funds. The Commission retained overall powers — under the Secretary of War — to set policy and amend the recommendations of the Board of District Engineers.

These administrative changes gained their meaning from a new national policy set by Congress in the same Act. The Commission was authorized "to build and repair levees if in their judgment it should be done as a part of their plan to afford ease and safety to the navigation and commerce of the river and to deepen the channel . . . ."[8] The Act appropriated $4.9 million for the Commission, and gave it charge of all Federal work for improving the harbors of Memphis, Vicksburg, Natchez, and New Orleans, plus the "rectifi-

cation" of the Red and Atchafalaya Rivers, which had previously belonged to the Memphis Engineer Office.[9] The gathering of all Federal work on the Mississippi into the hands of the Commission began with this Act. At the same time the job of executing Commission policy had been placed in the hands of the Engineers. Most important of all, a cue had been given as to how the Commission might enter levee work.

Delegations from the local levee districts waited on the Commission at its meetings in August and November 1882. They spoke with pathetic detail of the impoverishment of their people, of their own exhausted credit, and the helplessness of private initiative and local government to deal with the repeated disasters. Senator Lamar of Mississippi (the Senate manager of the bill that created the Commission) again signaled the intentions of levee advocates in Congress when he urged the Commission to build levees first "where obstructions to navigation are the greatest." The point of this approach was the claim that crevasses caused shoaling of the channel. The citizens of Greenville, Mississippi, argued that the caving of the riverbank before their town was destroying navigation by the "correspondingly rapid formation and growth of the already extensive sand bar upon the opposite side" of the river. A petition of 11 parishes of Louisiana called the Ashton crevasse "the immediate cause of bad navigation at this point." On 16 August 1882 the Commission went into executive session and entered upon the work of flood control.[10]

Maj. Charles R. Suter of the Corps of Engineers made the motion that the Commission divide the river into four districts.[11] He also moved that $1.5 million be allotted to the levees, and, amended to $1.3 million, the motion was adopted the next day, with only Comstock recording himself in opposition.[12] Suter's districting motion was then adopted. The Commission, in the course of two days, had emerged from its chrysalis and embarked upon the work that was to transform middle America.

The development of the levee system that followed was marked by enormous advances in technique and organization. The *how* of levee building was enormously advanced — where it was not created from scratch — by the Commission. Proper selection of levee sites (often considerably back from the river, to the dismay of riparian landowners), complete clearance of the soil, removal of stumps, construction to specified height and cross section, sodding of the levees with Bermuda grass, forbidding cuts and drains, outlawing the use of levees as roadways, all came to form part of a comprehensive set of standards, which the control of Federal money made enforceable.[13]

No technical advance was more important than the Commission's work on revetment. Eads had used the willow mattress as the foundation of his jetties. The Commission adapted the willow mattress to the purposes of revetment by spreading it over the riverbed below water to protect the bank against the undermining action of the water. This method, first devised to protect the banks against eddies above the permeable contraction works, was later used to protect the levees, especially in concave bends. District officers were constantly experimenting, hoping to improve the technique of revetment and to find replacements for the willows when the supply began to run low. As early as 1884 a proposal was made by a district engineer to use "concrete slabs, connected by iron rods, for revetment," an idea which was revived in different form a decade later by Maj. George Derby at New Orleans. (Derby was experimenting with plank mattresses, and hoped to use concrete as a ballast material.) The Engineers at Vicksburg are generally credited with developing the articulated con-

FLOOD OF 1882
OVERFLOWED AREAS
IN
ALLUVIAL VALLEY

Scale: 10 5 0 10 20 30 40 50 MILES

LEGEND

Areas overflowed

This area outside of the Alluvial Valley overflowed by the Arkansas River.

92°00′ 91°00′ 90°00′ 89°00′

37°00′ 36°00′ 35°00′ 34°00′ 33°00′ 32°00′ 31°00′ 30°00′ 29°00′

Cape Girardeau
CAIRO
Columbus
Hickman
Fulton
MEMPHIS
Little Rock
Pine Bluff
Arkansas City
McGehee
Marianna
Helena
Greenville
Lake Providence
Yazoo City
Vicksburg
Natchez
Monroe
Alexandria
Simmesport
Angola
Baton Rouge
Morgan City
Greenwood
NEW ORLEANS
Bonnet Carré
Caernarvon
Fort St. Philip
Fort Jackson
Head of the Passes

MISSOURI
KENTUCKY
TENNESSEE
MISSISSIPPI
ARKANSAS
LOUISIANA

CURRENT RIVER
ST FRANCIS RIVER
CASTOR RIVER
LITTLE RIVER
OHIO RIVER
WHITE RIVER
BLACK RIVER
LITTLE RED RIVER
RED RIVER
CACHE RIVER
CROWLEYS RIDGE
TALLAHATCHIE RIVER
YALOBUSHA RIVER
WOLF RIVER
BIG SUNFLOWER RIVER
YAZOO RIVER
BIG BLACK RIVER
TENSAS RIVER
BOEUF RIVER
BARTHOLOMEW
MACON
LITTLE RIVER
BAYOU MACON
BAYOU TECHE
VERMILION RIVER
BAYOU BOEUF
BAYOU LAFOURCHE
HOMOCHITTO R
TANGIPAHOA R
AMITE RIVER
PEARL RIVER
LAKE MAUREPAS
LAKE PONTCHARTRAIN
LAKE BORGNE
MISSISSIPPI SOUND
BRETON SOUND
BARATARIA BAY
GULF OF MEXICO

crete mat in its modern form, and despite experiment with asphalt and other materials, this has become the standard modern method of revetment.[14] This is a single example of the many developments in survey, research, and experiment that laid the foundation for the modern science of controlling the river.

Progress in organization moved hand in hand with progress in technique. The Commission pressed for, and largely achieved a thoroughgoing integration of Federal and State effort in the field of flood control, an event whose importance could hardly be exaggerated. For the first time in history a truly national policy emerged for the national problem of the Mississippi Valley. Some idea of how the integrated system worked can be gained from a brief review of the setup in the New Orleans District.

Under the reorganization of 1882 New Orleans became the headquarters of the Fourth District of the Mississippi River Commission. In contrast to the New Orleans Engineer Office, the Fourth District reported to the Mississippi River Commission, and the Chief of Engineers could veto its projects (after 1892) but could not initiate them. Its duties concerned the river exclusively, while the Engineer Office took charge of the Delta below the Head of Passes, and the lakes and lesser streams.

The Fourth District contained the six State levee districts of Lower Tensas, Atchafalaya, Lafourche, Barataria, Pontchartrain, and Lake Borgne. While these districts supplied the majority of the funds for levee building, the fact that the Commission supplied approximately one-third enabled it to set the standards except for purely private levees. These generally remained below standard grade. As its work progressed, the Mississippi, in Louisiana as elsewhere, came to be enclosed by a patchwork of levees, some Federal, some private, most built by the levee districts with or without Federal aid. If, looking back, we see largely a picture of confusion, an officer who was long in charge of the Fourth District, the austere and firm Maj. George McC. Derby, saw the same thing. Ending his report upon the great flood of 1897, Maj. Derby expressed his "surprise that so large a measure of success can be achieved by such unsystematic efforts."[15] But the success was achieved. "For the first time in the history of the river," reported the Commission after 1899, "a great flood passed between banks from Red River to the Gulf. The whole sugar country, where inundation means destruction, was saved from overflow."[16]

That the system worked was due in part to the American ability to make do, and in part to the unifying influence of the Commission and the Corps of Engineers, which did the Commission's work. Under the command of the district engineers, the levees were divided into stretches, each under a civilian employee — a Junior or Senior Engineer — who walked his stretch at least once a month. The local levee districts maintained the levees within their boundaries, but in time of danger turned to the Commission engineers to coordinate the work of floodfighting.

In fact a floodfight overrode all barriers. In time of danger, the depot maintained by the New Orleans Engineer Office made all possible supplies available. Commission engineers coordinated the work of state and private interests. In the 1897 crisis, Maj. Derby counted "six independent forces which assist in the work, the individual planter, the railroads, the parish, the levee district, the State and the United States." Thirty years later a civilian assistant engineer employed by the District recounted that in the Pontchartrain area, "about 95% of the supervisory personnel was [sic] unpaid civilians and officials of the Railroads, Levee Boards, Louisiana State Highway Commission, the Standard Oil Company at Baton Rouge, officials of the Sugar Refineries, Oil Refineries, Saw

Mills, . . . and from practically every manufacturing plant and farm in the district." Short sections of the levee line were placed under the control of engineers from the Louisiana Highway Commission. Planters and foremen of mills turned out to supervise the work of their employees on the levee, and afterward "submitted pay rolls from the time rolls of their foremen."[17]

This was the way floods were fought until 1928. Between crises districts like Maj. Derby's strove to complete the mainline levee system, standardize it, and raise it to grades that made it effective in restraining all but the largest floods. The result of their work was, without exaggeration, one of the most remarkable engineering achievements of civilized man.

It is against the background of these achievements in technique and organization that the most controversial aspect of Federal policy — the commitment to flood control by "levees only" — must be viewed. "Levees only" did not mean that the only activity of the Commission (to say nothing of the Crops) was building levees. It did mean, however, that within a startlingly short time after 1882 levees had come to be accepted — by the majority of the Commission, by the levee boards, by Congress and apparently by the people of the Valley — as the only flood-control work that should be attempted, and as the *raison d'etre* of the Commission itself.

The reasons for this policy have been debated by every historian who has dealt with the Mississippi River Commission. It is clear enough even to non-engineers that a levee system, by confining the river at flood stages and by cutting off its natural drains back into the swamps, must raise flood heights. Indeed, the fact was often discussed by members of the Commission, and yet no alternative plan was admitted to serious consideration. The question is then: how was the building of levees transformed with such bewildering speed from a daring innovation into a fixed and exclusive dogma? How did the Commission come to confine its own ideas, even more effectively than it confined the river, between those walls of earth?

The usual explanation of "levees only" holds that it was advocated in Humphreys and Abbot, and that their influence combined with the usual forces of organizational inertia to preclude change.[18] Certainly the influence of the *Physics and Hydraulics* was great. And everyone knows that there is a general tendency for practical expedients to turn into dogmatic rules. But the conventional explanation seems inadequate for a number of reasons. For one thing, the Commission did not hesitate to oppose Humphreys and Abbot whenever it wished to do so. In its search for justifications to be used in repairing the levees, for example, the Commission held that crevasses caused shoaling of the channel, a point which the *Physics and Hydraulics* specifically denied.[19] Again, the Commission sponsored a study which showed conclusively that the Mississippi's bed of "ancient blue clay" had no existence outside the pages of Humphreys and Abbot.[20] And this was by no means a purely theoretical question, for the Commission wished to show that a leveed stream would scour a deeper channel for itself, compensating for the increased flood heights caused by confinement, while Humphreys and Abbot had insisted that the "blue clay" was no more susceptible of scour than marble.

In short, whenever the *Physics and Hydraulics* contained statements that contradicted the Commission's desire to build levees, its contentions were firmly denied. Apparently the Commission used Humphreys and Abbot with a good deal of freedom. It did not build levees because of Humphreys and Abbot. It embraced or rejected the conclusions of Humphreys and Abbot insofar

as they would help it to build levees.

Perhaps after all the source of the policy is to be found in the political and economic facts of the situation. There is good evidence that by the mid-1880's Congress and the War Department had become disenchanted with the works of channel improvement. Senators from the riparian States frankly urged the Commission to exercise its powers upon levees and let other works take second place. The Secretary of War disapproved the contraction works in 1887, and the Commission resolved to build no more, only maintaining those which already existed. The money was applied to levees. On 30 June 1887 Senator Gibson of Louisiana "congratulated the Commission upon the fact that their recommendations had not been approved by the Secretary of War. The sentiment of the two Houses was opposed to revetment. The contraction of the river by levees is the proper method of procedure."[21]

The flood of 1890 brought in renewed applications from local groups for assistance in completing their levee lines. Local officials, pleading that the burden of debt was too great to bear, often made no effort to justify their requests by the navigation plea.[22] Congress' response was the River and Harbor Act of 19 September, which for the first time omitted the proviso against building levees for flood control.[23] Though the prohibition later reappeared in one act, the effects of this flood were decisive.[24] In its *Proceedings* the Commission recorded the claim of the railroads to levees as protection for their lines; the emphatic support of Congress; and the open backing of levees by eastern capital, as the vice-president of the New York Chamber of Commerce led a delegation before the Commission to urge that "one half the whole appropriation" be spent in preventing inundations in the lower valley. One member of the Chamber "explained his conference with the President of the U.S., on the alluvial valley problem. He thought himself that every dollar practicable should be applied to levees."[25]

Now at last the "levees-only" doctrine was taken up as the official doctrine of the Commission. In a letter to Senator Gibson, Judge Richard Taylor of Indiana, a Commission member, wrote: "I am directed to say . . . that it is the opinion of the Commission that the alluvial valley of the Mississippi can be reclaimed and protected from overflow by levees, and in no other way."[26] Levee advocates in Congress, having brought the Commission to this viewpoint, pressed it to act as vigorously as possible, by spending authorized but unappropriated money in order to force the Congress to appropriate by pledging the faith of the United States.[27] In fact, this method of procedure was later allowed by Congress within limits set by law.

The movement now well underway was carried further as the Commission, early in 1896, proclaimed in effect that revetment as a means of stabilizing the river was economically unjustifiable and recommended that "the practical results contemplated by the Act organizing the Commission of deepening the channel of the river for navigation and the control of destructive floods, can be attained with greater economy and probability of success, and in less time by the dredging of obstructing bars in low water and the maintenance, in co-operation with the State and local authorities, of an effective levee system." Revetment was to be placed in selected reaches to prevent cutoffs and to protect harbors and threatened levees of "exceptional importance." When, on 3 June 1896, Congress enacted a new Rivers and Harbors Act over President Cleveland's veto, the opening of a 9-foot channel by dredging "from Cairo down" became national policy. A minority in the Commission, led by Amos Stickney, fought to have the allotment for bank revetment and channel work increased, but was narrowly defeated by 4-3.[28] The

contraction works were now largely abandoned, and the building of these useful works was not actively resumed until after 1928.

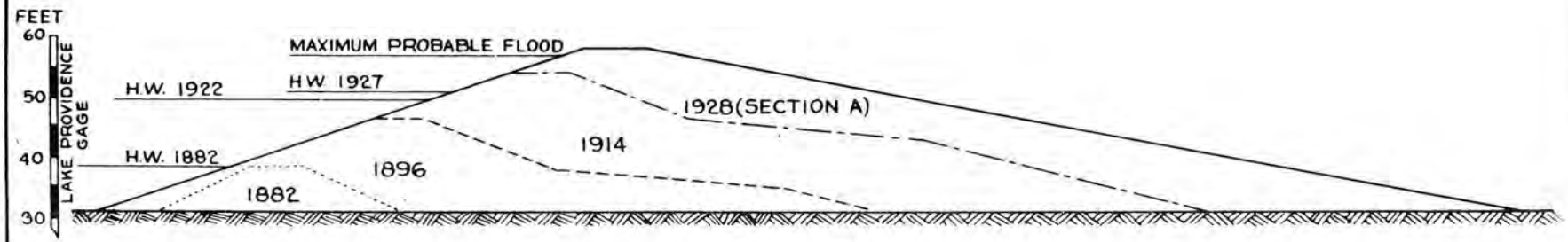
As this account shows, "levees only" reflected the opinions, not only or even chiefly of the Commission, but of those who had the ultimate power — of Congress, the War Department, powerful private interest groups, and the people of the Alluvial Valley. The reason is easy to see. As the Valley developed economically, flood control came to enjoy powerful backing throughout the eastern United States as well as in its old alluvial and western centers of power. Levees were simply the best established and most politically remunerative form of flood control. They were works that meant immediate protection for homes, businesses, and railroads. Other modes were experimental, lacked public and Congressional support, and were condemned by the leading authorities. In this case the conclusions of Humphreys and Abbot were accepted because the Commission had no particular reason to prove them wrong. "Levees only" became public policy because Congress wanted it, but once adopted, it had overwhelming attractions for the Commission itself.

From 1896 until 1927 the development of the Federal program was a matter of extension, definition and elaboration of existing policy rather than the introduction of new ideas. Levees were to hold out floods; dredging was to open an all-year channel; the District Engineers at St. Louis and Vicksburg carried on a program of snagging; the Corps was engaged in building a system of reservoirs at the headwaters of the Mississippi.[29] Add to these the programs of surveys and mapping, and the result is what might be called the classical form of Federal river policy. Compared with anything that had been done in the past, this matured program is profoundly impressive. Under it the levee system reached a condition of completeness never before known, while the all-year channel was achieved in 1907 by dredging.[30]

Yet the levees that protected the land against ordinary high water continually raised the crests of the great floods. As agriculture and industry prospered behind the walls of earth, the possible losses from flood increased as well. The number of human lives that a great flood would endanger rose with the water. Political and economic facts had led the Commission to adopt levees as the cure-all for floods in the Valley. Since in fact they were not a cure-all, total dependence on them represented a grave, though mostly hidden, danger.

The gradual buildup of floodwaters within the leveed channel was noted both inside and outside the Commission. Threats were occasionally made by riparian landholders to sue the Commission on account of flood heights raised by its work. Following the record spring flood of 1903, a bulletin of the United States Weather Bureau estimated that the levees erected since 1882 had raised the floodwaters at Memphis "between 7 and 8 feet, the latter figure probably being more nearly correct."[31] After 1903, an increasing number of independent experts on the river began to demand some revision of the "levees only" policy, and citizens' groups were formed to push for change.[32] Yet the strongest flood-control associations, the most important levee districts, and the Commission kept to their established course.[33] By 1926 the Commission felt that the flood problem had been nearly solved by the levees, and that maintenance and bank protection would be the concerns of the future.[34] Yet in the autumn of that year certain signs began to appear that the levees were about to be subjected to another test.

In October, Maj. John C. H. Lee, the newly appointed District Engineer at Vicksburg, noted that the river had risen to 40 feet on



MAXIMUM STAGES
LAKE PROVIDENCE GAGE

HIGH WATER 1882	38.3 FT.
HIGH WATER 1922	49.5 FT.
HIGH WATER 1927	50.7 FT.
MAXIMUM PROBABLE FLOOD	56.5 FT.

THE ELEVATION OF THE MAXIMUM PROBABLE FLOOD INDICATED HERE, IS THAT CONTEMPLATED BY THE PRESENT FLOOD CONTROL PROJECT AUTHORIZED BY ACT OF MAY 1928.

YEARS OF ADOPTION OF STANDARD LEVEE SECTIONS NOTED ON DRAWING.

HIGH WATER STAGES SHOWN ON DRAWING ARE REFERRED TO LAKE PROVIDENCE GAGE.

AREAS OF SECTIONS

1882 SECTION	161 SQ. FT.
1896 SECTION	530 SQ FT.
1914 SECTION	2,158 SQ FT
1928 SECTION A	3,173 SQ. FT

STANDARD LEVEE SECTIONS
LOWER MISSISSIPPI RIVER

the Vicksburg gage.[35] He began to study the history of the gage, and found that it had reached 30 feet in October only six times in 54 years, and each time the spring following had brought extremely high water. He began a series of staff meetings to mobilize the resources of his district against the expected emergency.

The new year opened ominously, with a minor flood in January, and a somewhat higher one in February. In early March the waters fell somewhat, but toward the end of the month the seasonal rises of the Ohio, Missouri, and Tennessee showed not only a magnitude but also a degree of synchronization that plainly warned of a major flood on the way.[36]

The first three weeks were taken up with a slow rise culminating in disaster. From St. Louis to New Orleans the levees swarmed with men, struggling against the water in the upper Valley, and, lower down, building up emergency supplies against what the New York *Times* warned might be "the greatest and most damaging flood in the history of the valley."[37] The worst sign of all was the weather. Long ago Humphreys and Abbot had recognized that a great flood could only occur when heavy rains in the Valley itself were added to the water of the tributaries. The spring rains, especially in the middle Valley, were exceptionally heavy[38] and on the night of 15 April New Orleans had a deluge of almost Biblical dimensions — 14.01 inches.[39] On 18 April the river stood at 56.2 feet at Cairo, and the lowlands were flooding rapidly; there were 25,000 homeless, and at least 12 dead. The worst sufferers so far were Missouri, Arkansas, and Mississippi, with lesser areas inundated in Illinois, Kentucky, Tennessee, and Louisiana.

Near New Orleans armed guards patrolled the levees. The rule in great floods had always been *sauve qui peut*, every man for himself: everybody feared that his own levee might be dynamited by his neighbors to ease the pressure of the water. At Poydras, below New Orleans, four men approached the levee in a skiff one night. When they failed to answer a guard's challenge he fired. One man was killed. "Residents," noted the *Times* laconically, "had been warned not to approach the levees after dark."[40]

Cloudbursts fell in southern Kansas, raising the Arkansas, which broke through the levees in Pulaski County and flooded 15,000 acres of Arkansas' richest land. The Red Cross appealed for funds. Refugees poured into Cairo, St. Louis, and a hundred lesser spots. New York investment bankers, "fearing property which forms the basis of bond issues might have been damaged by the water," rushed inquiries to St. Louis. They were reassured to learn that the business district of the city was safe, and that the riverfront was "covered with small buildings" only. The reports did not say who, if anybody, lived there.[41]

Following the cloudburst of the 15th, New Orleans enjoyed several days of sunshine. The New Orleans Engineer District and the Fourth District labored to strengthen and raise levees in the area. But the river was rising at every gage from New Orleans to St. Paul, and every major tributary except the Cumberland and the Tennessee was also rising. On 20 April the gage at Carrollton stood at 20.2, up .1 foot from the day before.[42] The reports from upriver were an excruciating mixture of good and bad news. Whenever the Mississippi broke its levees the danger to New Orleans from the gigantic flood crest moving downriver was lessened to some degree. And as the crisis of 21-30 April began, there was little to be heard but of this sort of tragic blessing. The levees upstream were being overwhelmed.[43]

On the 20th the river reached 44.7 feet at Memphis and the levee broke at Clarendon, Arkansas. Miss Rosa Gibson, the town's telephone operator, watched from an upper

window of her office building as houses, animals, and river craft were washed down Clarendon's main street.[44] The mainline levee broke the next day above Greenville, Mississippi, flooding an area 50 miles wide and 75 miles long. Recalling the night of 20-21 April, Major Lee wrote, "No steamer was able to stem the current . . . . So, we rushed in sacks [for sand bags] by airplane, by small boats braving the swirling current of the Arkansas south of Pine Bluff. Labor consisted of white volunteers, of drafted Negroes, of National Guardsmen, and of convicts from the state farm. All worked side by side just as they would fight in a trench. They held this levee ten days and nights through wretched weather, cold and wet, until another attack developed just below and the forces had to be divided. It was then that the crisis came and South Bend went out. Defeat after a fight like that," said Major Lee, "is bitter."[45]

The refugee camps were flooding, and epidemics of mumps, measles, and whooping cough were reported among the survivors. At Little Rock, a train loaded with coal was parked on a steel bridge across the Arkansas to give it added stability. The bridge began to vibrate so intensely that the coal caught fire from the friction. Shortly afterward, bridge, train, and burning coal were toppled into the water.[46] At New Orleans men worked all night, by electric lights or lanterns, with the rain and chill of an unseasonal cold front blowing on them. Though the levees about the city itself were stronger than ever before, and despite the relief given by the crevasses upstream, engineers at New Orleans were already considering desperate measures. The Corps of Engineers reported to President Coolidge that the flood would be the worst in a generation, and George C. Schoenberg, chief engineer of the State of Louisiana, said publicly that a mainline levee break somewhere in the state had become inevitable.[47]

Meantime the Federal Government mobilized its resources, not to prevent ruin — it was too late for that — but to minimize the human suffering along the river. Maj. Gen. Edgar Jadwin, the Chief of Engineers, went to Memphis to take personal charge; a Presidential Commission under Herbert Hoover, the Secretary of Commerce, was set up to deal with the disaster; the President appealed for $5 million needed by the Red Cross; the activities of seven agencies of the Government were integrated in a massive effort at relief. But the greatest question of the flood remained unanswered: what would happen to New Orleans when the crest reached it?

To visitors the city seemed unchanged. Despite storing of food and other signs of the approaching crisis, noted the *Times*, "New Orleans, sitting serenely between the river and Lake Pontchartrain, with virtually the entire city of half a million below the river level, went calmly and unhurriedly about its ordinary work."[48] Something would have to be sacrificed, but New Orleans felt quite sure that the something would not be New Orleans.

On 26 April, late in the evening, Governor Oramel H. Simpson ordered the levee to be cut at Poydras Plantation, below the city. One hundred thousand acres were expected to be flooded, the water eventually to find an outlet through natural drains into Lake Borgne and the Gulf of Mexico. The evacuation of lower St. Bernard and Plaquemines Parishes had already been begun. "The breach," reported the *Times*, "will probably be made by the engineers of the State with approval of the engineers of the War Department. The step was recommended by the Mississippi River Commission."[49]

The finale went with a bang — and a fizzle. Trappers and farmers from the area to be flooded were reported guarding the levee with "machine guns, riot guns, rifles and pistols," but were expected to submit when the time came. Riotous public meetings were held, and

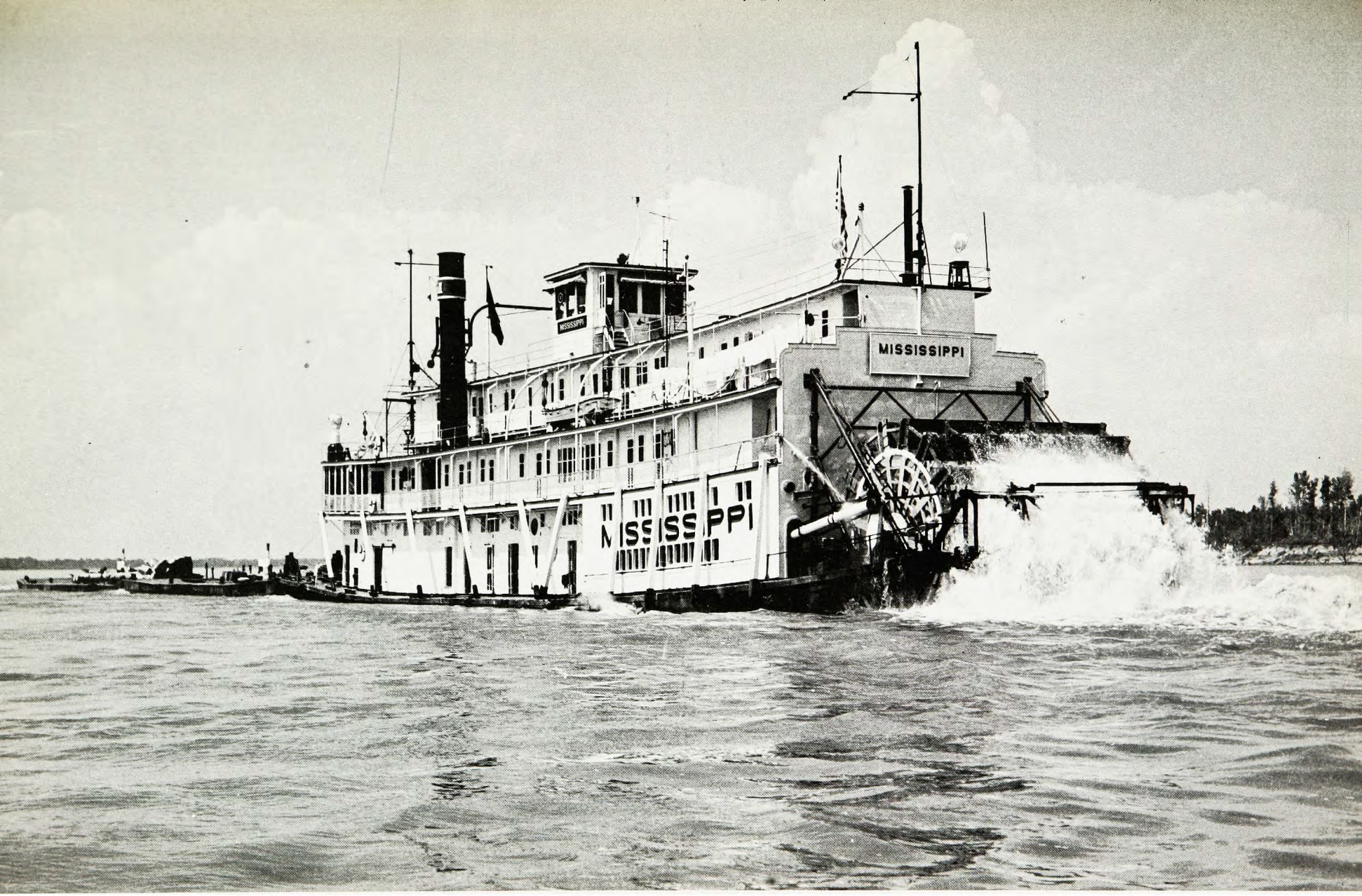


Fig. 1. Navigation on the Mississippi River – old style. The Commission's famed stern-wheeler "Mississippi".
(Photo by P. G. McKinney)

Fig. 2. Navigation on the Mississippi — new style. The 26,000-ton barge FREEPORT I being pushed by the towboat Allison "C," 1968.
(Photo by S. R. Sutton)

Fig. 3. Levee building — old style. Convict and free labor work side by side at the Morganza crevasse, 1890.
(Photographer unknown)

Fig. 4. Bank protection — old style. Weaving of a giant willow mattress, 1950.
(Photo by C. Fortier)

Fig. 5. "Walking on the water." Evenly distributed crushed rock gradually sinks a willow mat beneath the water. New Orleans, 1950.
(Photo by C. Fortier)

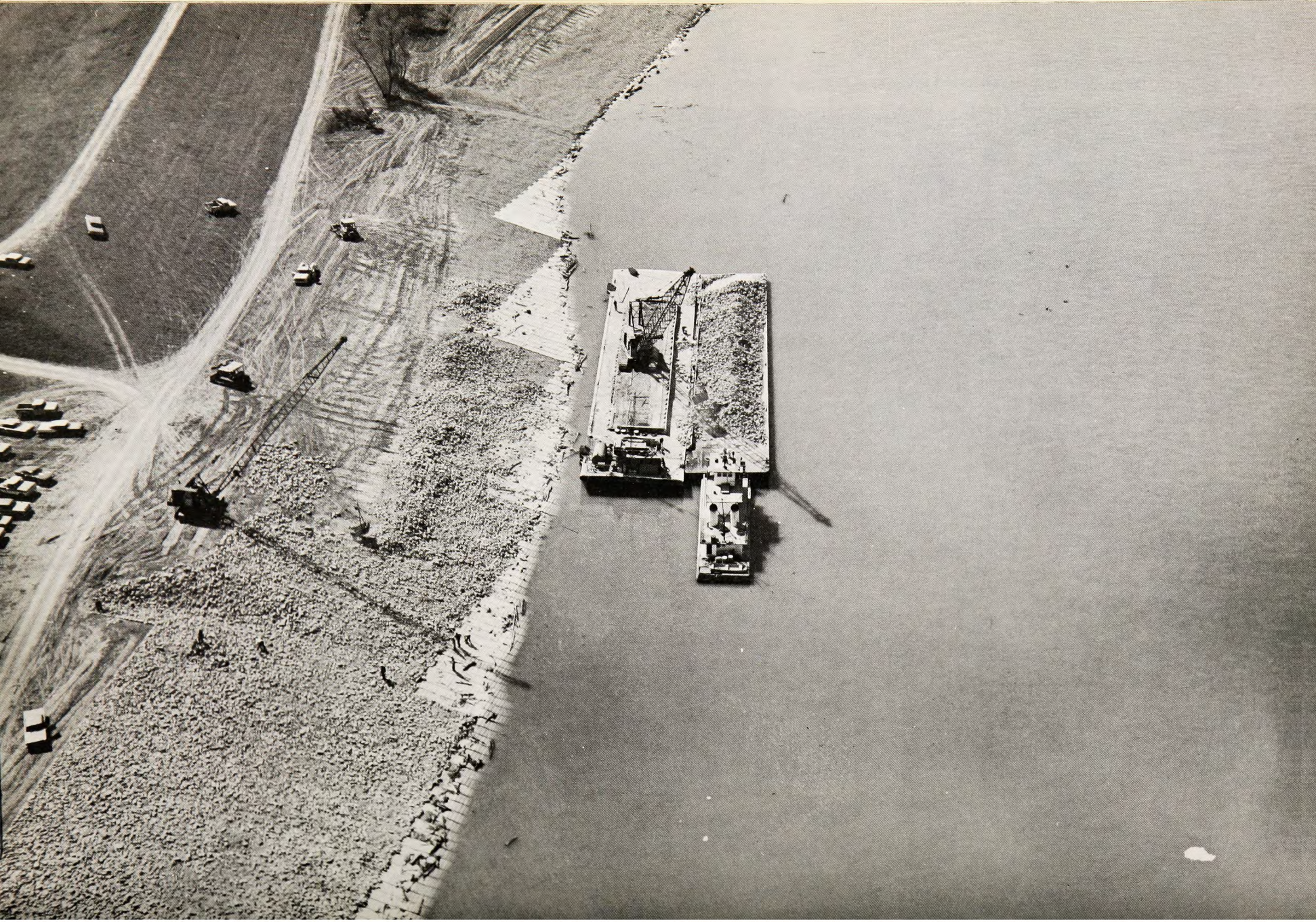


Fig. 6. Bank protection — new style. Riprap (broken stone) is laid to overlap the articulated concrete mats.
(Photo by S. R. Sutton)

Fig. 7. "Pulling a needle" at the Bonnet Carre Spillway during the floodfight of 1950.
(Photographer unknown)

Fig. 8. Morganza Control Structure nearing completion. 1953. This structure controls the entry of water into the East Atchafalaya Floodway.
(Photo by C. V. Dyer)

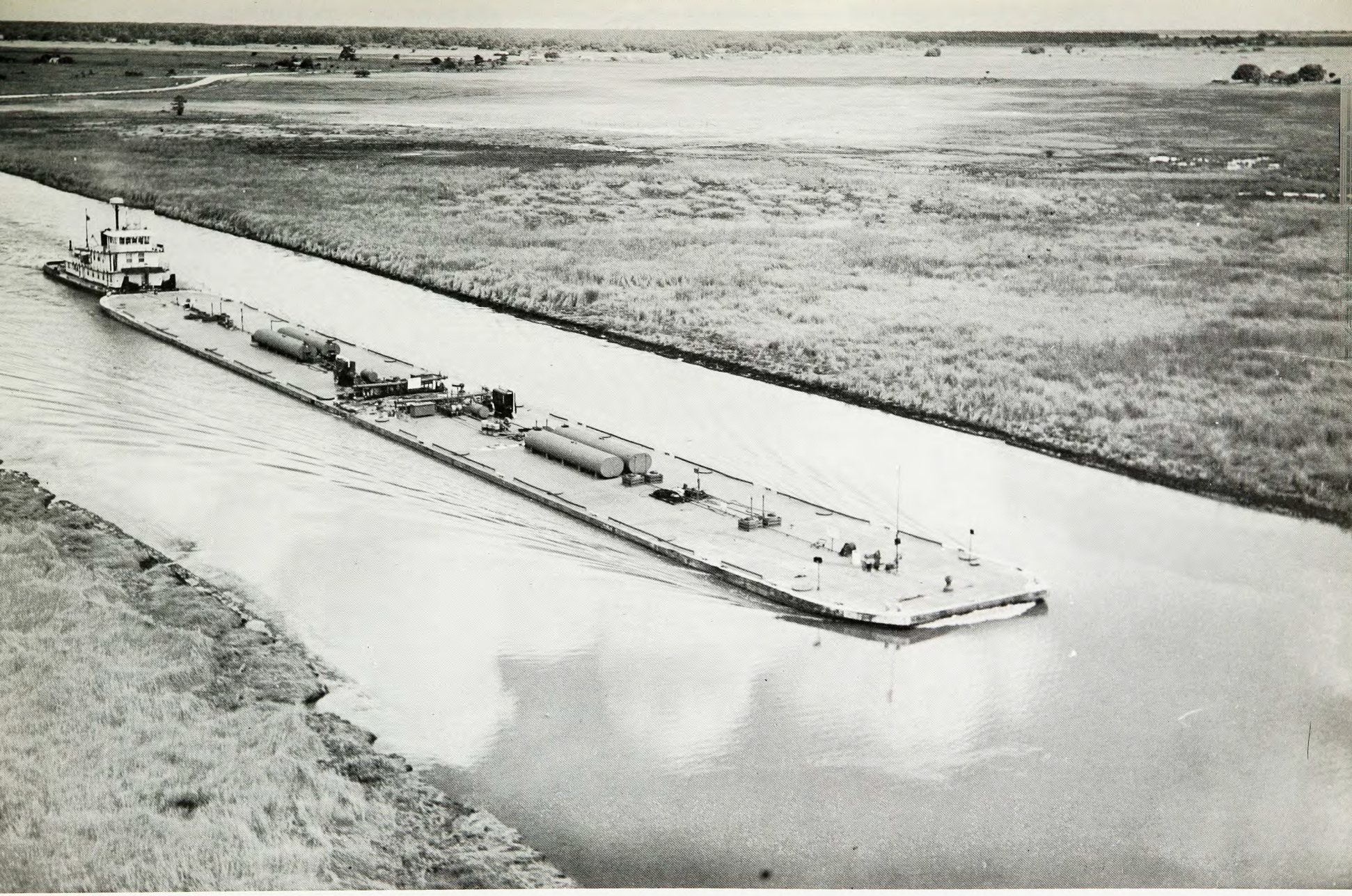


Fig. 9. Traffic on the Intracoastal Waterway. A football game could be played on some of the immense tows that pass through the waterway.
(Photo by C. Fortier)

Fig. 10. The Old River Control Structures. In this remarkable photograph, the Mississippi is at bottom, the Red River at top.
(Photo by E. Eskin, Jr.)

Fig. 11. The Mississippi River-Gulf Outlet east of New Orleans. At lower left is the Intracoastal Waterway; top, the Gulf of Mexico.
(Photo by S. R. Sutton)

Fig. 12. The Red River problem. Erosion, destruction of farmland, the shoaling of the channel that will follow — these are the effects of the undiciplined Red. *(Photo by S. R. Sutton)*

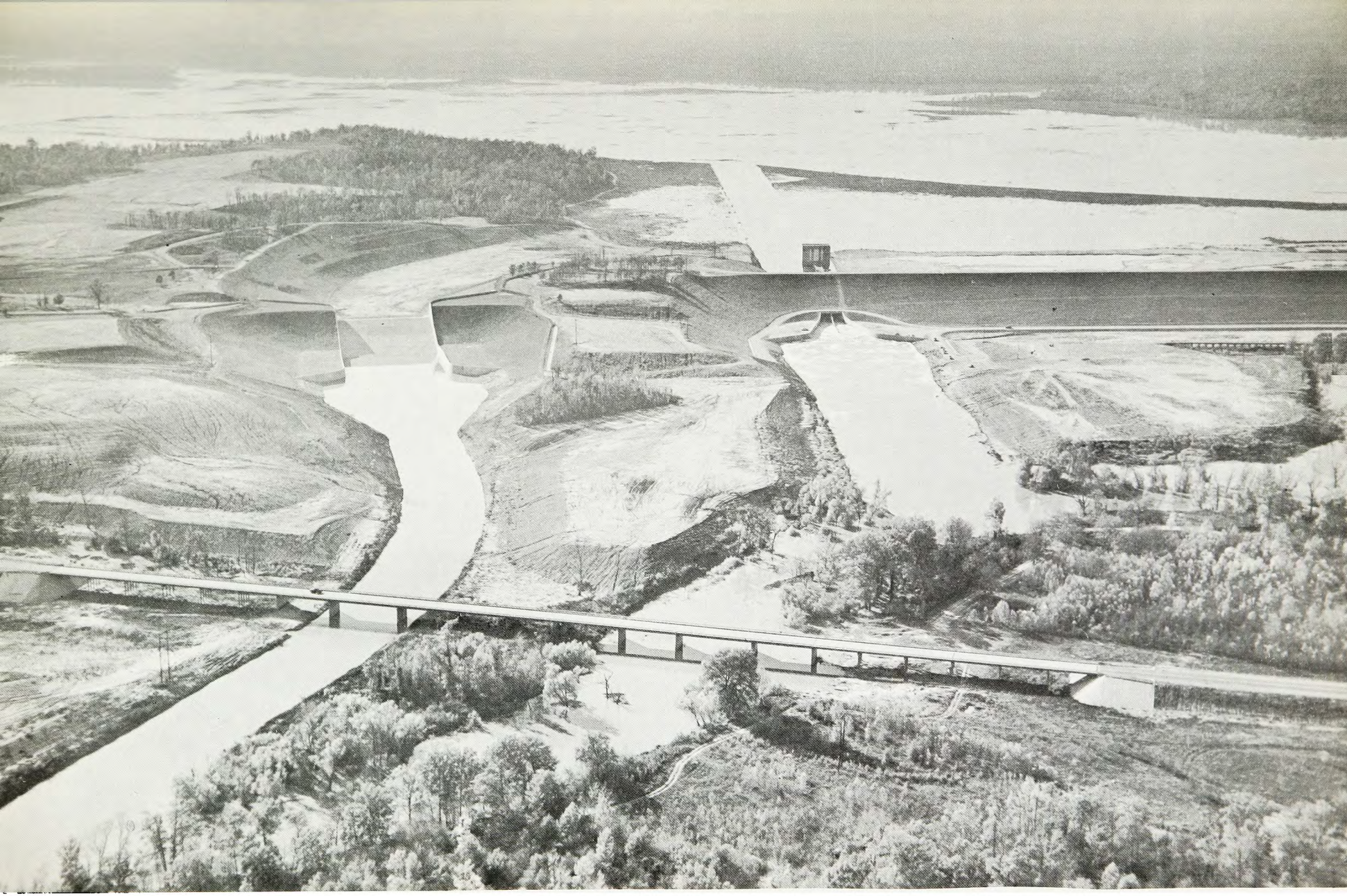


Fig. 13. Lake Texarkana under construction, 1954. This vast artificial lake now provides not only flood control for the Red River Valley but recreation for 2.5 million visitors a year. (Photo by S. R. Sutton)

Fig. 14. Hurricane surge — its meaning in human terms. The waters of Hurricane "Betsy," 1965.
(Photo by J. V. Crampes)

Fig. 15. The cleanup job — a new responsibility for the New Orleans District. New Orleans, 1965.
(Photo by R. N. Wicker)

state authorities made cheap and abundant promises of compensation, few of which were to be honored. Meantime, in New Orleans 500 "pump guns" were issued to patrol squads to guard against possible reprisals. An embargo was placed on dynamite sales, and 400 National Guardsmen were encamped above the city.

On 29 April six successive charges of dynamite breached the Poydras levee. Though 1500 pounds had been exploded, a reporter wrote angrily that "the awe-inspiring spectacle that had been promised was lacking. There was no gigantic torrent . . . There was the muffled sound of exploding dynamite, earth and stones shot into the air, and there was silence. The water seeped slowly, almost reluctantly, through the comparatively small holes and spread placidly over the land on the other side. Prosaic picks and shovels were called into play . . . News photographers and motion picture camera men registered intense disgust."[50] Hours passed before the crevasse slowly grew to the needed dimensions.

Perhaps the reporters would have been less disgusted if they had realized that the levee was the least of what the ineffectual dynamite had blown up. Coming at the end of that terrible April, when the levee system had been overwhelmed, 200 people killed, and 700,000 driven from their homes, the valley devastated, and $200 million in property losses recorded, the uninspiring blast at Poydras might have been taken as a far more significant sound. A policy had been breached, and the pouring waters were sweeping an era away.[51]

CHAPTER FOUR: PROJECT FLOOD

The flood of 1927 confirmed the worst fears of opponents of the "levees only" policy, and brought bitter criticism of the Commission.[1] Working under great pressure, Maj. Gen. Edgar Jadwin, the Chief of Engineers, found a way through the tangled scientific, political, and economic difficulties which surrounded the question of flood control and gave direction to a Congress and a public angry over the past and confused by conflicting proposals for reform.

The Jadwin Plan utilized work done by the Commission in developing its own scheme of flood control, and in many essential features the two programs were identical. The concepts of the Commission were, however, modified in important ways by the conclusions of four Engineer boards working for the Chief, and the new plan was infused with Jadwin's energy, clarity of expression, and political astuteness.[2] Finally adopted through the work of a commission created by Congress in the Flood Control Act of 15 May 1928, the plan provided the key to the modern system of flood control at a price Congress was willing to pay.[3] The document is one of the most remarkable in the history of the Corps and of the Mississippi Valley.

What Jadwin proposed to do was to restore to the river by artificial means what the levee system had taken away. First he defined a "project flood" — the flood that the Weather Bureau called the "maximum possible" and the Commission the "maximum probable" that could occur in the Valley. This flood would result from perfect synchronization of the highest known rises of the tributary systems with the most unfavorable recorded rainfall conditions in the Valley itself. This apocalyptic event would bring flood heights of 66 feet on the Cairo gage and 74 feet at Arkansas City, with a flow of 3 million cubic feet per second below the mouth of Red River. This was the yardstick by which all proposals for flood control were to be measured, and, despite changes in detail, it retains today the critical function that Jadwin assigned it 42 years ago.[4]

The project flood could not be met by strengthening the levees. As Jadwin's successor, Maj. Gen. Lytle Brown, was to write a few years later:

> The cost of levees on the Mississippi increases more rapidly than the square of their height, and the destructiveness of a crevasse increases almost in like proportion . . . levees are not fixed . . . they must, on occasion, be rebuilt in new positions due to bank erosion. Consequently, they must not be too costly. All conditions demand levees of limited height, and the limit is soon reached.[5]

The myth of the all-sufficient levee system was gone forever. What could take its place?

Basically, Jadwin's plan combined a strengthening and very moderate raising of existing levees with a program designed to restore *during great floods only* the width of channel that the levee system had cost the river. A system of floodways and spillways would duplicate the effects of the swamp reservoirs and natural outlets while protecting the flood plain from inundation. In Missouri, the Birds Point-New Madrid floodway would draw floodwaters away from the meeting place of the Mississippi and Ohio at Cairo, Illinois, and return the water to the mainstream below. The Arkansas River similarly would be relieved by a floodway in the Boeuf River basin, a natural channel of escape which local interests had closed off with levees. Finally, the Delta would be protected by a floodway that made use of the great natural distributary of the Atchafalaya. At Old River the project flood would be divided in halves, with 1.5 million cubic feet per second passing down

the basin of the Atchafalaya to the Gulf. The special problem of New Orleans would be met by a spillway above the city at Bonnet Carré, where another 250,000 second-feet would be guided out of the main channel and into Lake Pontchartrain north of the city.[6] The floodways, as envisioned by Jadwin, would increase the carrying power of the river, protect vulnerable areas, and split up the superflood among three outlets to protect the Delta.

Jadwin thought they would not be too expensive.[7] He proposed to control the entry of water into the floodways by "fuse-plug" levees instead of expensive artificial works — low levees that were designed to protect against ordinary stages of the river but which would crevasse in great floods.[8] Once within the floodways, the water would be guided by lateral earthen levees. Only at Bonnet Carré did Jadwin contemplate the use of an artificial control structure. In the 12 years or so that usually elapsed between great floods, the land within the floodways would be available for a variety of uses, including cattle raising and many types of farming. The residents of these unfavored areas would have no valid reason for complaint, in Jadwin's view, since the proposed floodways were all natural outlets which went under water anyway during great floods. Economically and politically, as well as in the engineering sense, Jadwin saw the floodways as the line of least resistance, and, despite the intense local opposition that developed when the plan was announced, he was by and large right in thinking so.[9]

His plan contained other important elements. He recommended that 80 percent of the cost of the project flood system be borne by the Federal Government.[10] He proposed a unification of the chain of command by making the Mississippi River Commission an advisory body and requiring that the offices of president of the Commission and Engineer of the Lower Mississippi Valley Division be held by the same man. Since this man would be a brigadier general in the Corps of Engineers and the executive officer of the Commission, power both to initiate and to veto flood control projects on the Mississippi would be lodged in the Office of the Chief of Engineers.[11] Finally, Jadwin recommended the creation of a hydraulic laboratory under the Commission, to coordinate field data and experiment with small-scale models of the river. Old themes of the river's history — the scientific inquiry that had begun with the Delta Survey, the expansion of Federal power, the concentration of that power in the hands of the Chief of Engineers — were carried a long step further when the Jadwin Plan became law.

Before describing how the plan was put into effect, some background must be given on the development of flood control policy in the United States in the twentieth century. The flood of 1927 could hardly have provoked such a comprehensive answer as the Jadwin plan if the American people and their government had not matured considerably in their attitude toward their natural resources in general and the needs of the Valley in particular.

The early decades of the century had seen a succession of great floods, each of which provoked new demands for action.[12] As the previous chapter has shown, the action that was taken was limited by the "levees only" concept, and consisted largely in the Commission raising again and yet again the standard grades for levees along the river.[13] But the floods also produced new thinking in and out of Congress, which, however, did not result in significant changes in policy until after 1927.[14] However, the authority of the Commission was gradually extended over the entire Alluvial Valley above the Head of Passes, and up the tributary systems as far as the backwater curve of the Mississippi af-

FLOOD OF 1927
OVERFLOWED AREAS
IN
ALLUVIAL VALLEY

Scale: 10 5 0 10 20 30 40 50 MILES

LEGEND

Areas overflowed

Levee system

CREVASSES

Bougere No. 1

Bougere No. 2

McCrea Crevasse

Melville Crevasse

Cabin Teele Crevasse

Glasscock Crevasse

Brabston Crevasse

Knowlton Crevasse

Pendleton Crevasse

Medford Crevasse

Laconia Crevasse

Winterquarters Crevasse

Whitehall Crevasse

Dorena Crevasse

Mound Landing Crevasse

Caernarvon Artificial Crevasse

Junior Crevasse

This area outside of the Alluvial Valley overflowed by the Arkansas River

Cape Girardeau

Commerce Hills

Cairo

Columbus

Hickman

Fulton

Memphis

Little Rock

Pine Bluff

Arkansas City

McGehee

Greenville

Lake Providence

Vicksburg

Natchez

Alexandria

Simmesport

Angola

Monroe

Marianna

Helena

Greenwood

Yazoo City

Baton Rouge

New Orleans

Morgan City

Caernarvon

Fort St. Philip

Fort Jackson

Head of the Passes

Bonnet Carré

Pointe Coupee

Plaquemine

Donaldsonville

Lake Maurepas

Lake Pontchartrain

Lake Borgne

Mississippi Sound

Breton Sound

Barataria Bay

Gulf of Mexico

Missouri

Illinois

Kentucky

Tennessee

Mississippi

Louisiana

Current River

St. Francis River

Castor River

Little River

Ohio River

White River

Black River

Red River

Cache River

Bayou

Big Sunflower River

Coldwater River

Little Tallahatchie River

Tallahatchie River

Yalobusha River

Wolf River

Homochitto River

Tangipahoa River

Amite River

Pearl River

Big Black River

Vermilion River

Lafourche

37°00′

36°00′

35°00′

34°00′

33°00′

32°00′

31°00′

30°00′

29°00′

92°00′

91°00′

90°00′

89°00′

fected them.[15] This extension and unification of authority provided the organizational base for implementing the new flood control plan when it came along.[16]

But there were deeper changes at work too, altering the American people and transforming their concepts of government, as the Civil War had changed them in the past. Up to the First World War, the American political scene was dominated by recurrent demands for reform in almost every aspect of national life. The Progressive Era, as it was called, was dramatized by Theodore Roosevelt and resulted in the enactment of far-reaching reforms under Woodrow Wilson. One notable feature of this time of change was the fact that reformers of all political parties looked to the Federal Government to achieve their ends. During this time flood control became so firmly fixed as national policy that no further identification of it with a single political tradition is possible. Moreover, under the Progressive impulse, new concepts emerged of the conservation and development of resources, which in time were combined with flood control to produce the first programs of comprehensive waterways development. In fact, "comprehensive" became something of a catchword of the time; it referred both to broad programs of flood control that went beyond "levees only" and to the idea of many-sided development for waterways, in which flood control was only one of many essential parts.[17] Moreover, these ideas continued and in fact developed during the conservative decade of the 1920's and, after the great flood, burgeoned in truly gigantic fashion during the New Deal reforms of the 1930's.

Landmark laws were passed in three successive decades. The reforming impulses of Woodrow Wilson's New Freedom produced the Flood Control Act of 1917.[18] Though this law in no way represented the real entry of the Federal Government into the field, it was important for two reasons. First, it swept away the pretense that levee building was intended only to benefit navigation, and proclaimed openly that flood control was a proper activity of the national government. It did not begin the era of Federal flood control, but it did end the era of Federal subterfuge. Second, the law established standards for Federal-state cooperation, providing that one third the cost of flood control works should be paid by the Federal Government and two thirds by local interests. This was about the proportion that the Commission had been using anyway, but the statutory requirement provided a firm and explicit basis for future efforts which benefited and encouraged the movement toward integrated effort among many levels of government. Shortly afterward, the Federal Government began a massive program of encouraging the rebirth of trade and commerce on the Mississippi, with the result that the waterway was able to play a broad role in the nation's war effort and a great rebirth of waterborne commerce took place.[19] In both navigation and flood control the Wilson administration was a time of progress, reborn effort, and new ideas.

As if to signalize the bipartisan nature of the new approach, the next decisive changes took place under that stern Vermont conservative, Calvin Coolidge. A paragraph hidden away in the Rivers and Harbors Act of 3 March 1925[20] opened the way to comprehensive planning for waterways development. Flood control, navigation, power production, and irrigation were declared to be interdependent aspects of waterways development, which must be considered together in planning for the use of the nation's rivers and lakes. Under Coolidge too the integrated response of seven Federal agencies to the crisis of 1927 foreshadowed future methods of disaster relief. The President seems to have intervened at several points in the evolution of the Jadwin Plan, and ultimately proclaimed

it as the guide to the nation's new flood control program. The plan that Coolidge had approved was carried into effect under those bitter political and ideological rivals, Herbert Hoover and Franklin D. Roosevelt. Henceforth, practically anything about Federal flood control might become a political issue, except the basic principle itself. That had become the nation's business, and so it has remained.

A third and most important law was the Flood Control Act of 22 June 1936, which repeated in the strongest terms yet employed that flood control was national policy, and established the cost-benefit ratio as a yardstick for determining whether specific works should be undertaken. Specifically, the law declared that flood control improvements should be carried out if the benefits, to whomsoever they accrued, were in excess of costs.[21] For 35 years this standard has provided the Corps with its most important yardstick for judging new projects. Though it has been the root of many controversies, as might be expected, at the time it was devised it indicated a broad new concept of the duties of the national government to "promote the general welfare."

Clearly the country had come a long way since the Commission used to justify closing crevasses on the ground that levees when washed into the river constituted a danger to navigation. The new approach had its own inadequacies, of course. The standards which Congress set for the Engineers were still almost exclusively economic. Competitive goals of recreation, conservation, and the enjoyment and use of nature for non-economic purposes were left in the air, to be settled piecemeal by Congress or by power struggles among competing Federal agencies. Yet at the time they were adopted, and in the years since, these changes in organization, standards, and fundamental law brought far more benefit to the United States than many a victory on the battlefield.[22]

The adoption of the Jadwin plan brought extensive responsibilities to the New Orleans District. It did not, however, bring any real organizational changes. The old Fourth District of the Commission, after passing through a brief rechristening as the New Orleans River District, was renamed the Second New Orleans District and placed under the Mississippi River Commission, with headquarters at Vicksburg. The former New Orleans Engineer District became the First New Orleans District, remaining subject to the Gulf Division with headquarters at New Orleans. The task of building two great works under the Jadwin Plan — the Bonnet Carre Siillway and the Atchafalaya Floodway — fell to the Second District.[23]

The actual progress of work under the plan suggests that Bonnet Carré enjoyed top priority, with the Birds Point-New Madrid Floodway a close second. This was to be expected, since New Orleans and Cairo were the two spots on the river where considerable urban populations were in direct danger from floods. The Atchafalaya Floodway — a truly gigantic job — was also undertaken rapidly, but its ramifying complexities have not been completely solved to this day. The Boeuf Floodway lay outside the New Orleans District in northeastern Louisiana, and no full account of its troubles can be given. It may be noted, however, that this was the area where the Jadwin Plan encountered the most determined opposition from local interests, that plans for the Boeuf were set aside in 1935 in favor of the Eudora Floodway east of the Macon Ridge, and that the whole project was abandoned in 1941, when the cutoff program made it possible to lower flood crests on the Mississippi with far less political opposition.[24]

The story of Bonnet Carré really began before the Jadwin Plan itself. On 17 April

1926 Congress passed an act directing the Secretary of War to make surveys and cost estimates for controlled spillways between Point Breeze and Fort Jackson, Louisiana. This was during the time when advocates of comprehensive flood control programs were battling the "levees only" policy of the Commission, and the work was given directly to the Corps of Engineers, with the Commission being ordered to transmit information desired by the Secretary of War to a group of officers known as the Spillway Board.[25] By the time the board's report was ready, the flood of 1927 had occurred, and Jadwin incorporated the board's proposals in his overall plan for the river. Though some important technical changes were made in the process, the board had the unique experience of seeing the essence of its proposals enacted into law within a few months.[26]

Bonnet Carré was the general name for the land lying near a rather notorious bend of the Mississippi about 30 miles above New Orleans.[27] The east bank of the river here had a history of presistent crevasses, including very great ones in 1871 and 1874.[28] The idea of creating an artificial outlet to Lake Pontchartrain where nature seemed anxious to force a natural one had early occurred to students of the river. William Darby described the possibilities in laymen's terms in his *Geographical Description of the State of Louisiana*, published in 1816, and his idea continued to attract attention throughout the nineteenth century. Humphreys and Abbot went at some length into the possibility of creating an outlet at Bonnet Carré, only to reject it for fear that the river would make the outlet its main channel, or, alternatively, would silt up Lake Pontchartrain.[29] Of course, these were serious objections, since the idea of a temporary and controlled outlet was not worked out until the twentieth century.

The Jadwin Plan adopted the spillway plan as a means of preventing the Carrollton gage in upper New Orleans from exceeding 20 feet. Basing his estimate upon past performance (which again proved unreliable) Jadwin predicted that the spillway would be in operation 1 to 3 months out of every 5-year period. Actually, it has only been opened three times in the 41 years since President Coolidge approved the final site, 6 miles south of Laplace, Louisiana, on 21 November 1928. However, this has been quite enough to justify the spillway's existence; the investment of $13.6 million in construction and the subsequent maintenance have three times been the key to preserving the half million lives and billions of dollars in property values in the densely settled lowlands of New Orleans and its east-bank suburbs.[30]

The urgency of the need was clearly attested by the speed of the usually deliberate Federal establishment in beginning and carrying through the work. The Flood Control Act was approved on 15 May 1928; the site of the spillway on 21 November; on 15 December "equipment had been placed on the site for the driving and testing of piles, the drilling of test holes and for the carrying out of all other necessary foundation tests; in addition, the first unit of a hydraulic laboratory has been constructed for the purpose of making the required hydraulic experiments."[31]

The site of Bonnet Carré was typical of the Delta region. From the natural bank of the river 14 feet above Gulf level, the land sloped away to an elevation of 2 feet 2 miles away and about 1 foot at the shore of Lake Pontchartrain. This meant that the last 5 miles of the floodway was virtually level, swampy land, covered with cypress, gum, ash, and cottonwood trees, and with a dense, semitropical undergrowth. As defined by its side levees, the floodway was to be shaped somewhat like a broken fan, expanding from a width of 1.5 miles at the spillway control

structure to about 2.4 miles at Lake Pontchartrain. The natural levee was "generally cleared and . . . susceptible to cultivation," while the swamp was worthless as farmland. A dense, almost impervious clay overlay the land, while underneath a mixture of clay and sand permitted the percolation of ground water at a slope roughly even with that of the surface, the water not finding its level until it emerged into Lake Pontchartrain. Three railroads passed over the site — the double-tracked Illinois Central, and the single-tracked lines of the Louisiana Railway and Navigation Company and the Yazoo and Mississippi Valley. There was one important road, the Jefferson Highway.[32]

The gateway that would control the flow of river water into the spillway closely resembled an irrigation dam. Though construction of such a work "in the dry" was in some ways an unusual problem, the principles involved did not differ essentially from other dams which the Corps had already built elsewhere, and a study of existing structures throughout the country preceded work on Bonnet Carré. The prime scope for ingenuity lay rather in working out the hard details under conditions where theory had to anticipate practice. Working under the direction of Maj. E. S. J. Irvine and senior hydraulic engineer I. A. Winter, the Second New Orleans District undertook the construction of ingenious models to represent in miniature the complex forces of the river in spate. Their experiments were the key to the success of Bonnet Carré, as well as being fascinating examples of the art of the engineer.[33]

A field laboratory was established at the site. The questions to be answered were the best form for the dam, the best means of quieting the tumultuous entry of the floodwater to a uniform flow, and effects of that flow upon the floodway itself. Two flumes were constructed, one to contain a 1/6 scale model of a spillway gate and the other a 1/20 scale model of a unit of 22 spillway gates. Even the forest was reproduced. The number and size of the trees in a typical acre were established by surveys, and a scale model of the forest was built, with wires for saplings and wooden pegs for trees. Then a working model of the entire project was made — weir, floodway, levees, forests, railroads, highways and a section of Lake Pontchartrain. The Engineers determined that, except for an eddy formed at the first turn in the lower levee, the full width of the floodway would be an effective channel, and even the troublesome eddy would disappear before reaching the forest. By these means, the most effective form of the spillway was worked out to very high standards of accuracy and the way prepared for actual construction.[34]

Meantime other tests were being carried out with structures as massive as the models were small. In building the spillway, as in all large structures designed for the Delta, the ability of the soil to bear heavy weights and of pilings to endure soaking in the saturated subsoils were matters which required the fullest examination. Pilings were driven and loads of up to 120 tons were tried upon them to test the rate of sinking. As usual, no stratum was found for the piles to rest upon — their "bearing value" was entirely frictional. Consequently loads had to be very exactly balanced to prevent failure of a foundation that was, in effect, floating in the soil. On the other hand, untreated wooden pilings proved to be extraordinarily durable, provided that no air was allowed to reach them. In the neighborhood of Bonnet Carré timber foundations were found, half submerged in ground water, which had been "in existence for almost a century without the slightest sign of decay." The Engineers opened the base of the Lee Monument in New Orleans and found much the same story. In 50 years, the timber and piling buried in moist earth were sound, while at a higher level, timber surrounded by dry earth showed clear evi-

dences of decay. While these tests were carried out in the field, soil permeability was being tested at the laboratories of Tulane University. Models, test pilings, field examinations, and laboratory work gave an extraordinarily comprehensive picture of the region, and of the most promising form for the engineering structures to be erected there.[35]

As finally projected, the weir was a concrete structure resting upon timber piles 65 to 70 feet long. On the riverside, a line of interlocking sheet steel piling prevented lateral "flow" of the soil caused by the weight of the weir and also prevented percolation of water through the porous subsoil. Baulks of wood ("needles") formed the weir gates; in time of need these could be removed one by one to "take off the crest of the flood." Behind the spillway weir was a stilling basin, consisting of a concrete apron with baffles to break the inflow of water and reduce the velocities which might otherwise endanger the weir and floodway behind it. Riprap covered by articulated concrete slabs completed the structure by preventing undermining from the rear.

Work was begun at once and by 10 February 1931 the spillway weir stood complete, a triumph of ingenuity and craftsmanship.[36] The summer of 1932 saw the guide levees on both sides of the spillway brought to final grade, except for gaps at the highway and railroad crossings. Work now began on the bridges that were to carry the rail and highway traffic across the spillway, and by the midsummer of 1936 the crossings had been completed and the gaps in the guide levees closed. The end of the year saw the completion of work on the Mississippi levee that fronted the weir, to protect the forebay from driftwood. Lowered in the conventional "fuse-plug" pattern, dressed, and sodded with Bermuda grass, the correction of the levee formed the last element in the work, and in December 1936 the Chief of Engineers was able to announce that the entire floodway project stood complete. The timing was theatrically close. In January 1937 one of the greatest of all recorded floods started on its way down the Mississippi.[37]

Very heavy winter rainfall in the Ohio River Valley produced the truly gigantic flow of 1.85 million second-feet at Cairo. Fortunately, this immense crest moved alone; an earlier flood on the White had already passed, and the upper Mississippi reserved its waters until May. Still, the Ohio flood was met at Cairo by a flow of 164,000 second-feet from the upper river, which meant that over 2 million second-feet were moving down the Valley in January.[38] Gage readings frequently exceeded those of 1927. To save Cairo, the Birds Point-New Madrid Floodway was opened by dynamiting the fuse-plug after it failed to crevasse.[39] Cairo was saved, and, though the levees had to be sandbagged and backwater areas were badly flooded, the mainline levees held. Local misfortunes and suffering occured, requiring the Red Cross and the National Guard to be called out, and the Public Works Administration and the Civilian Conservation Corps provided labor forces for sentry and maintenance work along the levees. But there was no comparison with the ruin of 1927. Men might begin to hope — cautiously — that a single decade had solved the flood problem of centuries. One test remained, however, in the Delta, where all the upstream waters must be funneled safely past New Orleans and discharged into the Gulf of Mexico. The fresh sod on the levee at Bonnet Carré would have no chance to root itself after all.

The Natchez gage recorded the highest water in history. As they had upstream, local and Federal agencies turned out to sandbag levees which had not yet been raised to the 1928 grade. There were gaps in the Atchafalaya levees that had to be hurriedly filled, and plank revetment to be laid down along the mainline levees of the Mississippi for pro-

tection against the extreme pressures and very high current velocities. The broad, deep channel of the lower river accommodated the flood well enough so that the fuse-plug levees at the head of the Atchafalaya did not go out. But when the water rose to the mark of 20 feet on the Carrollton gage, the Bonnet Carré Spillway was opened for the first time. The drawing of the needles continued until, on 18 February, 285 of the 350 bays were flowing. A week later the flow reached its maximum peak of 211,000 second-feet — well within the capacity of the floodway, but an awesome sight, as those who were present recall.[40]

Giant trees were uprooted and swung like flails against the remaining forest. A thousand men worked around the clock, clearing drift from the floodgates, laboring on the guide levees and deflection dikes, and maintaining a constant watch over the first man-made outlet of the Mississippi. An elaborate information-gathering service was set up, with 153 gages extending from the weir forebay to Lake Pontchartrain. Radio and telephone maintained constant contact among the work parties, the patrols, the spillway control points, and the Second District office. As the waters began to fall, gradual closing commenced on 7 March, and continued for nine more days, holding the Carrollton gage about stationary.[41]

When the last needle fell back into place on 16 March 1937, an extraordinary moment in the river's history had passed. It passed quietly, as important moments so often do. The report of the Commission recounted the event without rhetoric. Among other developments, it described the successful passage of "The High Water" — not the flood — of 1937.[42] No more than that seemed necessary.

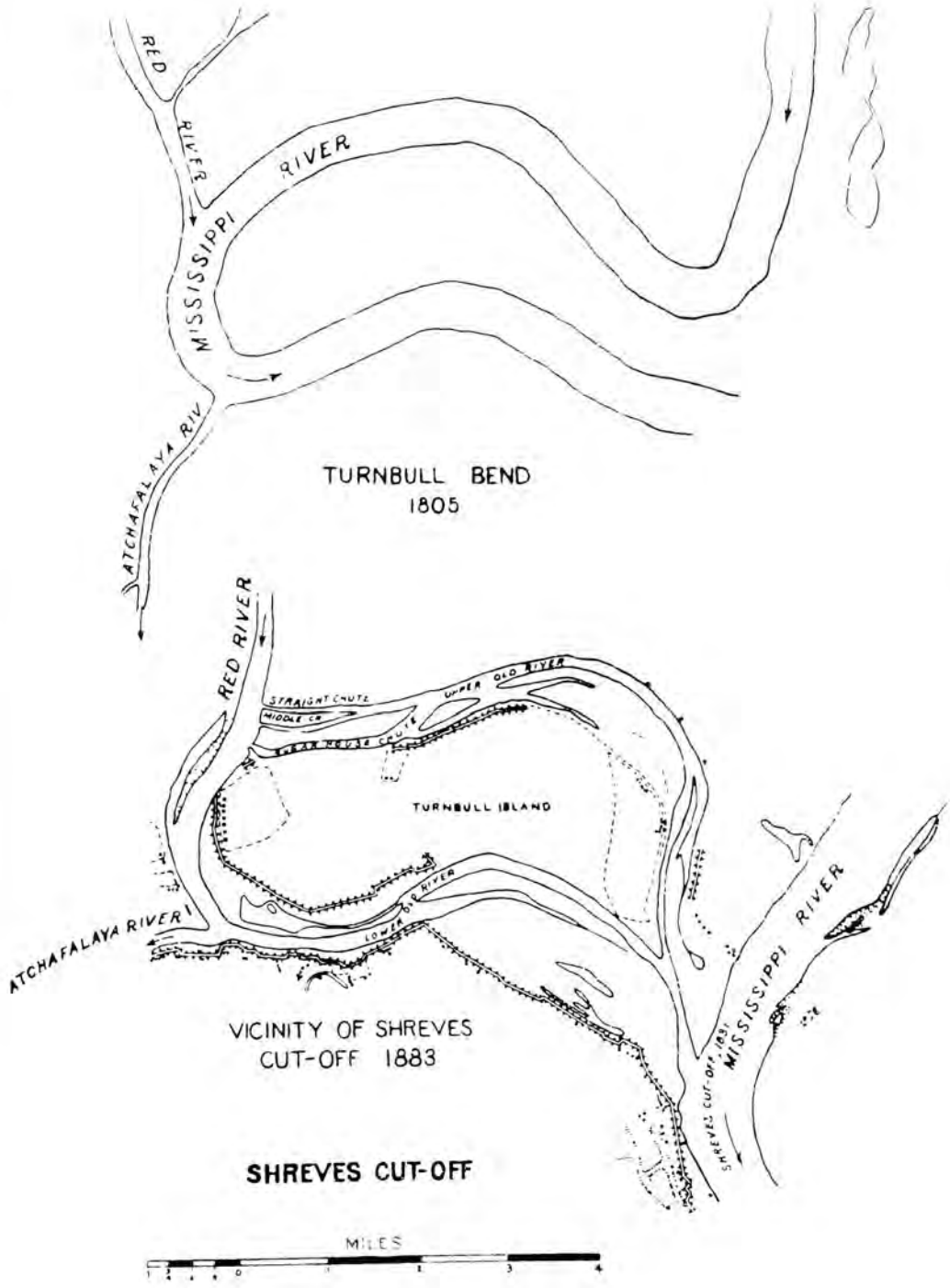
The Atchafalaya Basin was a part of the flood control system that presented the Engineers with unique problems. The greatest of all distributaries of the Mississippi, the Atchafalaya is, in Fisk's words:

> A complex stream which flows partly in its own channel, partly in a channel inherited from other streams; which possesses a single channel for only part of its length; which builds a delta into a lake system along its course; and which finally flows from the lake system into an arm of the sea through several channels.[43]

The Atchafalaya is so complex largely because it is a new stream still in process of creation, and one which has been shaped to an extraordinary degree by the human activities which have surrounded it for a great part of its life.

The Atchafalaya was created during the fifteenth century A.D., when an enlarging loop of the Mississippi, later called Turnbull's Bend, broke into the basin of the Red River. Water from the great river was forced down a small distributary of the Red which flowed south into a marshy valley between the Teche and Lafourche ridges. In the valley was a large lake formed by the drainage from the ridges, a lake which had already found an outlet to the sea through the channel that is now called the "lower Atchafalaya."[44] When the first Europeans arrived, they found the Atchafalaya a well-defined distributary flowing out of Turnbull's Bend a few miles south of its confluence with the Red. The distributary was so placed, however, that it became a trap for drift timber brought down by the two rivers that fed it. By 1778[45] a great raft had formed near the head of the stream, effectively blocking its further enlargement.

At this point human beings began to tinker with the Atchafalaya. As settlement proceeded in its valley, the obstruction of navigation by the raft became increasingly burdensome to agricultrual producers, and during the great drought of 1839 settlers set fire to the raft and burned it to the waterline. The next year the State of Louisiana began clearing out


RED RIVER
MISSISSIPPI RIVER
ATCHAFALAYA RIV
TURNBULL BEND
1805
RED RIVER
STRAIGHT CHUTE
UPPER OLD RIVER
MIDDLE CO
TURNBULL ISLAND
LOWER OLD RIVER
ATCHAFALAYA RIVER
VICINITY OF SHREVES
CUT-OFF 1883
SHREVES CUT-OFF 1831
MISSISSIPPI RIVER
SHREVES CUT-OFF
MILES

the underwater logs with snagboats. Though the raft periodically re-formed, it was just as persistently broken up again. By 1880 the Atchafalaya was permanently clear and rapidly enlarging. Unhappily for the people of the valley, it enlarged from north to south, flooding out long-established plantations and farms, whose owners used up first their profits and then their capital in "building and raising levees to restrain the augmenting floods from above," as the Mississippi River Commission reported in 1881.[46] Much of the land returned to nature, bankrupting many of those who had sought to make their river a navigable stream. And there was a further danger in what was taking place, though few remembered that in 1804 the officer who took possession of upper Louisiana for the United States had written:

> . . . the channel of the Chafalia, a few miles only from the head of [Red River], is completely obstructed by logs and other material. Were it not for these obstructions, the probability is that the Mississippi would soon find a much nearer way to the Gulf than at present, particularly as it manifests a constant inclination to vary its course.[47]

Meantime, in 1831, Capt. Henry M. Shreve had cut off Turnbull's Bend.[48] The abandoned bend, whose arms were known as Upper and Lower Old River, showed the customary tendency to silt up, and in fact first the southern and then the northern arm did close. According to Fisk, both the channels would eventually have become permanently filled if left to themselves, and the Red-Atchafalaya would have formed a single river running parallel to the Mississippi.[49] Here again, however, human beings took a hand, dredging out the lower channel in order to maintain navigation and trade. The Corps of Engineers considered and rejected a variety of plans for dealing with the region — wisely, it would seem, because the hydraulic conditions had become so complex that it was difficult to make any move with assurance of what its ultimate effects would be. Lower Old River became a channel in which the current flowed west or east according to the relative stages on the Mississippi and the Red. During a period of observation in 1881, assistant engineer W. Marshall Rees of the Memphis District found that the current flowed eastward for 56 days, westward 56 days, and was still for 13 days. Maj. W. H. H. Benyaurd warned against the enlargement of the river, but under the circumstances there was little to be done. The Atchafalaya was now carrying the whole volume of the Red, except during floods, and part of the Mississippi during its high water stages as well.[50]

This was still the general aspect of the region in 1928, when the plan for the project flood was adopted, except that sill dams had been laid down near Simmesport, Louisiana, to decrease the flow in the Atchafalaya. The Jadwin Plan contemplated using the great distributary for three converging floodways[51] that were to carry half the project flood out of the main channel for the preservation of the Delta. The sill dams were allowed to decay and were finally destroyed in 1939-1940 as part of the program to open an efficient channel down the Atchafalaya.[52] A variety of other measures were undertaken to make the river an efficient floodway: a single channel was dredged through the delta above Grand Lake, levees were straightened and extended, and a new outlet created between lower Grand Lake (Six Mile Lake) and the Gulf. All these measures were necessary to the flood control plan, but they contributed to the ever increasing diversion of the Mississippi.

By 1940 the Atchafalaya was providing the great river with a route to the sea that had a three-to-one advantage to slope over the old channel past New Orleans. Any need to dredge Old River had long since ceased. The

channel was rapidly enlarging, while the Mississippi just below Old River was beginning to fill — a loss of cross section that spoke plainly of the decrease in current velocity caused by the Old River diversion. The last year in which significant eastward flow was observed was 1942, when the current moved toward the Mississippi for a total of 9 days.[53] A study conducted by Commission geologists in 1951 indicated that the capture of the Mississippi by the Atchafalaya channel was only a matter of time.[54] As it had done so often in the past, the Mississippi was preparing to find a new, shorter and steeper route to the sea.

In 1953 a team of geologists directed by Dr. Harold N. Fisk reported to the Commission that the change would reach a critical stage during the decade 1965-1975, when 40 percent of the Mississippi's flow would be diverted and deterioration of the main channel would become irreversible.[55] There would be no great danger to the port of New Orleans in the event of a diversion of the Mississippi, but the problems of drinking water and waste disposal in a tidal estuary were sobering. The elaborate flood control apparatus, erected over the course of two centuries on the lower Mississippi, would become useless. The Atchafalaya Basin would face the danger of disastrous floods. And the Old River channel could not merely be blocked off, for the Atchafalaya was still essential to the project flood. All in all, the diversion threat was the gravest danger that had yet appeared to flood control in the lower Valley.[56]

Congress' response was the act of 3 September 1954, which provided for control structures at Old River which in effect transformed the Atchafalaya into a gigantic controlled floodway/spillway system. An "overbank structure" resembling the spillway weir at Bonnet Carré was to control the passage of floodwater into the Atchafalaya; a "low sill structure" in a dredged channel paralleling Old River was to regulate flow during periods of low water. A navigation lock was provided to make the Red-Atchafalaya accessible to river traffic from the Mississippi, and when this work was completed the mouth of Old River was sealed off. Meantime, the Morganza control structure had been finished in June 1956, completing the work on the eastern channel of the floodway. By these works the Atchafalaya — most complex of all the floodway projects — was secured against the danger of becoming a permanent channel while simultaneously being preserved as an efficient and dependable temporary channel for the Mississippi in time of flood.[57]

As might be expected, the existence of so vast a structure as the Atchafalaya Floodway has brought curious problems in Louisiana. Like any other alluvial stream the Atchafalaya has been at work, building land and changing the shape of its own course. The inefficiency of its lower channel has caused constantly rising stages upstream, and soil instability makes the maintenance of levee grades exceptionally difficult. But the development of a stable channel is only one of the problems raised by this curious region.

The basin — especially the East Atchafalaya Floodway — contains great wilderness areas, so much so that it was recently described by a project engineer as "the last frontier." efforts to have the region turned into a wildlife conservation area have so far been unavailing. Another problem is that of drainage. Levees cut across natural drainage, block running streams, and generally obstruct the natural distribution of fresh water. In consequence, the Engineers have taken care to divert fresh water through drainage structures at Bayous Courtableau and Darbonne.[58] South of the distribution structures, drainage from the region west of the floodway (which formerly entered the Atchafalaya) now flows by a continuous chain of borrow pits to Charenton drainage and navigation canal, or by Bayou Teche through the Wax Lake Outlet into the

Gulf. Similarly, on the east of the floodway drainage moves by Grand or Bell River to Lake Palourde or Verret and thence to the Gulf Intracoastal Waterway and the Gulf. Thus the whole drainage pattern of the region has been rearranged.

Finally, the basin — especially the West Atchafalaya Floodway — has attracted fishermen, hunters, and farmers. Despite the floodway easement written into all deeds (for which the Federal Government paid out considerable money) whole communities of farms and camps have sprung up, some representing heavy investments. People who have invested will, of course, exercise maximum pressure to prevent the floodway from being used for the purpose for which it was intended.[59] The complexity of maintaining and using the floodway is as great as the difficulty encountered in building it.

The Atchafalaya story, then, like the basin itself, is an unfinished work. The ever-changing Atchafalaya will require continuous tending during the foreseeable future. Moreover, the testing of the floodway during an actual crisis has yet to take place, though dynamite was ready during the flood of 1945 and the decision not to breach the fuse-plugs was, in the words of Col. George H. Hudson, the District Engineer at the time, "a matter of tenths of a foot."[60] The Atchafalaya Basin is a place where the work of creation, human and natural, is still going on, with no end in sight.

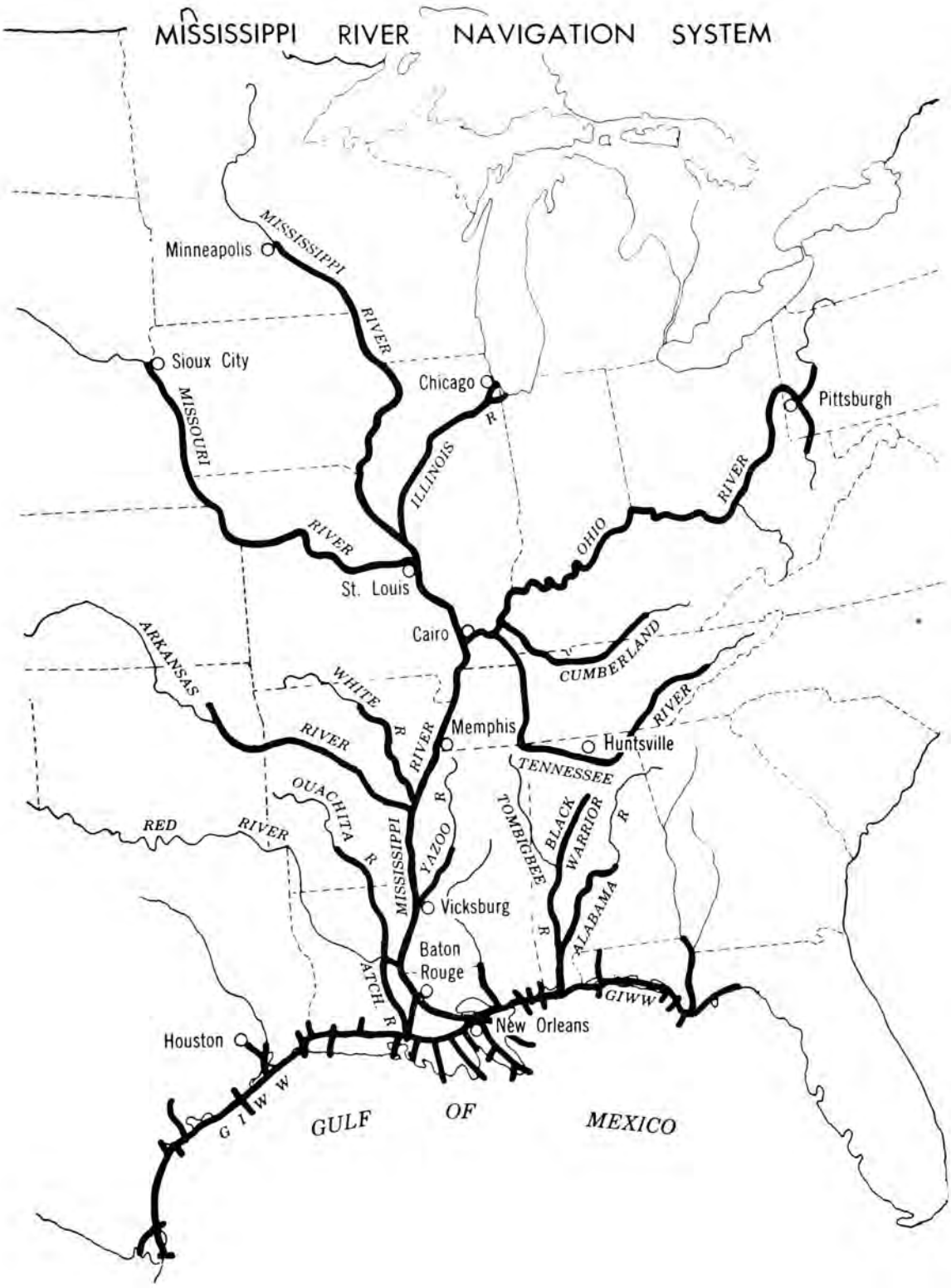
As a result of the program inaugurated by the Jadwin Plan and carried out by the Corps of Engineers in the 40 years since, the ancient theme of the Mississippi in flood tends to lose its atmosphere of crisis and tragedy. Though the project flood has yet to occur, there were very great floods in 1937, 1945, and 1950 which were passed successfully to the sea. The hundreds of millions of dollars invested in flood control have been repaid many times over in a multiplying population, industry, agriculture, and the development of recreational opportunities in the lower Valley. Furthermore, the solution of the old dilemma of flood control has opened the way to a broader development of the Mississippi and its great tributary systems for human use and enjoyment.[61] To all appearances, the conquest of the great floods has brought the river and its people into a new "regimen" in which the works of man have successfully and harmoniously supplemented those of nature. But in view of the extreme complexity and unpredictability of the river system, complacency is not justified. The river is not to be "bullied" — in Mark Twain's words — but to be lived with, and like any being that grows overly familiar, it may suddenly come out with some surprises.

The work of the Fourth District on the Mississippi has so far tended to overshadow the work of the New Orleans Engineer Office and its successors, the Engineer District and the First New Orleans District. At one time, under Howell, the office had taken charge of a broad range of projects, not only in Louisiana but in Texas. There had been no distinction between the work on the Mississippi River and that on the lesser streams, tributary and nontributary. The Engineer Office had handled it all. But when the work at South Pass was given to Eads (and later to his executors, who remained in control until 1901) and the Mississippi River above the Head of Passes to the Fourth District of the Mississippi River Commission, the Engineer Office was left with drastically curtailed responsibilities. From 1882 until 1901, it concerned itself almost entirely with the improvement of local waterways, with such special problems as control of the water hyacinth, and with the difficult but useful tasks of surveying and mapping a region that generally included southern Louisiana, eastern Texas, and the Homochitto River in Mississippi.[1]

The Engineer Office was more completely under the control of the Chief of Engineers than the Fourth District. Though the Chief acquired the power of vetoing work proposed by the Mississippi River Commission in 1892, he remained unable to initiate work. The Engineer Office, however, reporting directly to The Board of Engineers in New York, had no such autonomy. The major organizational change of the period came in 1888 when the Corps decentralized, grouping its local offices under Division Engineers. In the beginning, this change was purely administrative. Division Engineers stayed in New York, the center of Corps activity, and did not actually move into the regions for which they were responsible. Nevertheless, the creation of the divisional structure was an important step for the Corps, as Scheufele has said.[2] In time the Divisions would assume the significant roles of setting priorities, project review and budgetary control, freeing the Engineer Offices (or Districts, as they were renamed in 1915) for practical day-to-day executive action.

This separation and definition of duties, of course, only came about gradually; the situation at first was highly fluid. Sometimes the heads of Engineer Offices were also Division Engineers; sometimes executive control of projects was exercised by Division Engineers; sometimes overlapping of functions between the Division and Offices of the Corps and the Districts of the Mississippi River Commission occurred. For example, the New Orleans Engineer Office was at first assigned to the Southwest Division, whose chief was the president of the Mississippi River Commission. When the Gulf Division was created, the Division Engineer, Lt. Col. H. M. Adams, also served as Engineer Officer at New Orleans. For a few years in the 1880's, Col. Amos Stickney served both as District Engineer for the Fourth District and as head of the New Orleans Engineer Office. But as time went on, the duties of the different organizations and levels of organization were more accurately defined, and such overlapping became rare.[3]

In 1901 the Gulf Division was created, with headquarters at New Orleans, and the New Orleans Engineer Office was placed under its control. In effect, Major Chase's old command was brought back into existence, except that its headquarters was now at New Orleans, instead of Pensacola. Thus, by the turn of the century, the Engineers at New Orleans were linked to the Mississippi River by one chain of command, which ran from the Fourth District to the Commission, and thence through the


MISSISSIPPI RIVER NAVIGATION SYSTEM
Minneapolis
MISSISSIPPI RIVER
Sioux City
MISSOURI RIVER
Chicago
ILLINOIS R
Pittsburgh
OHIO RIVER
St. Louis
Cairo
ARKANSAS RIVER
WHITE R
CUMBERLAND RIVER
Memphis
Huntsville
TENNESSEE
RED RIVER
OUACHITA R
MISSISSIPPI R
YAZOO R
TOMBIGBEE R
BLACK WARRIOR R
ALABAMA R
Vicksburg
Baton Rouge
ATCH. R
GIWW
Houston
New Orleans
GIWW
GULF OF MEXICO

office of the Chief of Engineers direct to the Secretary of War. A second chain of command linked the New Orleans Engineer Office to the Gulf Division, and thence to the Chief of Engineers. If the commercial pattern of the Mississippi-Gulf system is thought of as an inverted T, with its point of intersection at New Orleans, the vertical bar fell under the Commission, the horizontal bar under the Gulf Division. The setup was entirely logical, and by no means as arbitrary as it might appear at first glance.[4]

With the coming of the twentieth century, the Engineer Office began once more to undertake large, significant works. The expiration of the maintenance contract with Eads' heirs brought South Pass back under its jurisdiction. To this was added, in 1902, the immense job of providing a jetty system for Southwest Pass.[5] Authorized in 1902 and completed in 1923, the huge jettied channel (35 by 1,000 feet) provided the broadest gateway yet into the Mississippi Valley. Finally, the decision of Congress to undertake the long-discussed Gulf Intracoastal Waterway led to extensive resurveys of the region, and finally to the construction of the Waterway itself. This was the most important work the District would undertake: by crossing the T of trade in the Mississippi Valley it helped to alter permanently the nature and quality of human life in the region which it served.

The idea of building a protected waterway along the Gulf Coast originated, like so many other Engineer projects, during the years of the American System early in the nineteenth century. The acquisition of Florida in 1819 created an ideal situation for east-west regional trade. The idea of connecting the Atlantic Ocean, Pensacola, Mobile, and New Orleans with its immense hinterland in the Mississippi Valley was one that fitted in perfectly with the feelings of the time.

In 1826 the Board of Internal Improvements under Brig. Gen. Simon Bernard surveyed the new frontier of the Gulf Coast and considered, among other topics, the problem of east-west trade. The Engineers concluded that a proposed "Canal across Florida" was not practicable, but recommended that coastwise traffic from Florida to New Orleans be rendered "secure, safe and commodious" by various improvements, including a connecting canal between Mobile and Pensacola Bays and between Lake Pontchartrain and the Mississippi at or near New Orleans.[6] Three thousand dollars was appropriated in 1832 to survey portions of the eastern end of the route.[7] Surveys for a ship canal below New Orleans were made in 1852, and in 1873 Howell at New Orleans and Damrell at Mobile drew up plans for connecting the Mississippi to Mobile Bay by a canal 7 feet deep.[8] In 1876 Humphreys discussed anew the question of connecting the Mississippi with the Atlantic via inland and protected waterways.[9] Appropriations, however, were apparently not made on any work directly associated with the eastern leg of the waterway until the twentieth century.[10]

The project for a western intracoastal waterway had a shorter history but was prosecuted with more vigor. A paragraph of the River and Harbor Act of 3 March 1873 provided that no more than twenty thousand dollars should be expended "For connecting the inland waters along the margin of the Gulf of Mexico, from Donaldsonville, in Louisiana, to the Rio Grande river, in Texas, by cuts and canals . . ."[11] Humphreys assigned the work to Howell,[12] and the work was concluded just about the time their feud with Eads got well underway. It was typical of Howell's wretched luck that the survey, taken too soon and completely overshadowed by the Eads affair, was forgotten for a generation.[13]

Howell based his report on extensive field work carried out by his civilian assistants J. A. Hayward, H. C. Ripley, and J. S. Polhemus.

The stretch from Galveston to Sabine Pass was surveyed in 1873, and the remaining work completed by 1875, Hayward working west from the Mississippi, Ripley moving east from Sabine Lake, and Polhemus west from Galveston.[14] They found the whole route desolate and difficult to traverse. Working in the hot season, on land that was partly swamp and partly desert, under a meager appropriation, it is easy to believe that "the young gentlemen," as Howell called them, "suffered hardships rarely met in the line of their profession."[15]

The route which Howell proposed on the basis of this survey would have begun at Donaldsonville, where Bayou Lafourche was to be dammed and ships transferred from the Mississippi by means of an inclined plane and turntable. The route would have left Lafourche by an existing waterway called the Attakapas Canal, which would have been extended to Lake Verret, and thence through Flat Lake to Brashear (Morgan) City. From that point Howell proposed alternate routes, to be adopted according to the amount Congress was ready to spend. The cheaper simply went down the Lower Atchafalaya and west along the coast through Atchafalaya, Cote Blanche, and Vermilion Bays. The costlier involved the use of Bayous Teche and Cypre Mort to provide an inland route to Vermilion Bay. West of this point the route would have cut across the *prairies tremblants* through White, Grand, and Calcasieu Lakes to Sabine Lake and the Texas border. Howell proposed to make use of bayous which he believed to be the remnants of natural connections among these bodies of water, and he admitted freely that the cost of maintenance was likely to be high.[16]

Indeed, costs were the whole trouble with Howell's waterway. His justification for the work rested almost entirely upon development which might result from the waterway itself. The acceptance by Congress of such justifications was by no means unknown, even in the nineteenth century, but only in the case of projects with glamor and powerful backing. The proposed waterway possessed neither of these advantages. The reports of the civil assistants leave an impression of a potentially rich but desolate region, with flooded swamps giving way to sandy wastes and then to grey cactus-covered prairies. On the whole it is not surprising that the project lapsed for 30 years, until a growing population, the discovery of oil, and the beginnings of industry enabled regional leaders to revive it.

The River and Harbor Act of 3 March 1905 revived the long-moribund project by providing for new surveys in Louisiana and Texas.[17] Donaldsonville was still regarded as the eastern terminus, and four sections were defined for survey purposes, three in Texas, and one in Louisiana. Maj. Edgar Jadwin, the future Chief of Engineers, reported upon the Louisiana segment, citing coal, rice, oil, sugar, lumber, and cotton as products for which the waterway was likely to prove important.[18] However, since the Federal Government was then engaged in clearing and providing a lock for Bayou Plaquemine, he recommended that this waterway be utilized instead of Bayou Lafourche. Jadwin's proposal would have greatly benefited Baton Rouge (and, in fact, a branch following a similar route was later added to the waterway) but at the time was unsatisfactory to New Orleans. By 1910 the maps submitted to the Chief of Engineers showed instead two proposed routes that led directly to the city's back door: the first by the privately constructed Harvey Canal from Bayou Barataria to the Mississippi, the second by another private waterway, the Company Canal, from Lake Salvador southwest of New Orleans to the river.[19] Yet cost still prevented the adoption of any overall plan. The Board of Engineers for Rivers and Harbors decided that prospective through commerce was still

not great enough to justify building a section here and there, and, if economic growth continued, others might be added in time.[20]

Thus the building of the waterway was like the forging of a chain. Nature had provided some of the links, but they lay scattered on the ground. A few connecting links would be added by men; the segment of the chain would be tested, and, if found satisfactory, another few links might be hammered out in time. "After careful consideration" the Board recommended that the Mermentau River be connected to the Teche at Franklin and Congress adopted the project on 2 March 1907.[21]

Once work began in 1908, regular appropriations permitted the first segment to be completed in a few years. It provided a maximum draft of 5 feet at low water and a bottom width of 40 feet.[22] The next part of the waterway — from the Mermentau to the Sabine River — was approved in 1910, on condition that local interests contribute the right-of-way and make up a cost differential of $27,000 between this and an alternate route.[23] These interests, organized as The Interstate Waterway League of Louisiana and Texas, secured the right-of-way with the assistance of the New Orleans Engineer Office, and provision was made for expanding the dimensions of the waterway. At long last the idea was spreading in Congress that this inglorious ditch through the swamps might have a bigger future than anyone had imagined.

The clearest indication of this was a declaration of policy that Congress wrote into the Rivers and Harbors Act of 3 March 1909.[24] Historians call the first decades of the twentieth century the "Progressive Era" — a vigorous time of nationalism and sweeping demands for reform. Under the leadership of Theodore Roosevelt and Woodrow Wilson, the nation made new beginnings in many fields, among others in the conservation and development of national resources. There was a general revolt against domination by the railroads, and new demands for a balanced transportation system. Under these impulses Congress wrote what can be considered the charter of the inland waterways, providing for a continuous waterway from Boston to the Rio Grande. This was not a mere fit of legislative exhuberance, for a comprehensive and fairly exact statement of the routes to be followed was provided the Engineers, who were to build the waterway. Implementing such a gigantic project was, of course, gradual and subject to the vagaries of fiscal rain and drought. But from this time forward it was an acknowledged national goal, and a striking practical achievement of the new concepts of national development which characterized the era.[25]

The war interrupted work but also provided a great stimulus to water transport that later benefited the inland waterways. Surveying was resumed in Louisiana when peace returned,[26] and an act of 3 March 1923 authorized and directed another fullscale survey from the Mississippi to Corpus Christi.[27] By this time, too, Congress had authorized the dredging of channels from New Orleans to Bayou Teche via the Harvey Canal-Lake Salvador route; from Franklin on the Teche to the Mermentau River; from the Mermentau to the Calcasieu; and from the Calcasieu to the Sabine. It was still admitted, however, that "no complete project . . . exists for the proposed waterway."[28]

The report of the Board of Engineers for Rivers and Harbors which made this admission in 1924 was basically a plea for a comprehensive program. As others had done before, the Board pointed out the advantages of connecting a western Gulf region, with its rich resources of oil, sulfur, timber, and agricultural products to the Mississippi-Ohio system. The rapid growth of the area provided strong arguments to the friends of the water-

way. The decade of the 1920's was a miraculous one for Houston, to name only the most obvious case. In 1920 Houston was a rambunctious town of 138,000; in 1930 it was reaching for 300,000 and was well started on its career as a southwestern Chicago. The critical economic fact, of course, was the development of the great southwestern oilfields in the same decade that mass-produced automobiles first turned America into a nation on wheels.[29] And Houston was only the most obvious case in a picture of regional growth, based on petrochemicals and other resources, that changed the waterway from a dream to an inevitability.

Under the direction of the Gulf Division Engineer at New Orleans, the new routes laid out for the waterway avoided the shallow tidal bays along the coast, where storm and tide contradicted the basic purpose of providing a protected slack-water route for commerce. In successive plans the waterway migrated inland, changing its form as the Engineers dredged whenever possible in straight-line segments across the swamp, instead of following the tangled skein of natural waterways. At the same time, more local canals were incorporated, since they had already been built where they could serve some profitable local trade.[30] The increasingly heavy private investment in terminal and handling facilities was sufficient to reassure even the administration of Calvin Coolidge that the Government was not likely to lose money invested in the region, and the Board of Engineers for Rivers and Harbors confidently predicted "a general commerce of at least 500,000 tons per year between New Orleans and points west."[31] In fact, the trade would swell to 100 million tons in 45 years.[32]

The Board's detailed and decisive report led Congress to authorize the expenditure of $9 million in 1925 to build the Louisiana and Texas Intracoastal Waterway, from the Mississippi at or near New Orleans to Galveston Bay, Texas.[33] In 1926, the Gulf Division Engineer was ordered to begin surveys for the eastern leg of the waterway as well.[34] In 1930, projects connected with this part of the waterway were authorized in the Rivers and Harbors Act,[35] and construction was underway the next year.[36] The way was now open, and the national need to provide work for the victims of the Depression brought support for this project as for many others. Today the waterway provides at least 12-foot depths from Brownsville, Texas, to Apalachee Bay, Florida. This is, however, by no means the end of the story.

The latest available report on the Chief of Engineers[37] gives the work of the New Orleans District as dredging and maintenance while awaiting funds to expand the waterway to the limits prescribed by the 1962 River and Harbor Act. Ultimately the segment within the District will be 384.1 miles long, 16 feet deep, and 150 to 200 feet wide. A new outlet for the waterway, dimensioned to the needs of the offshore drilling platforms, is the 84-by 600 foot lock and channel through Freshwater Bayou to the Gulf of Mexico. For a water highway which, in that same year, carried 42 percent as much cargo as the whole Mississippi River[38] the new dimensions are appropriate. Long prepared, slowly put together, and serving an area whose expansion seems assured, the canal that crosses the T of trade in the Mississippi Valley must be judged one of the most protracted, arduous, and successful regional achievements of the Corps of Engineers.

For a long time the efforts of the Federal Government to help the Port of New Orleans was directed entirely to improving the Mississippi. Its efforts to clear the Passes of the river have been recounted at some length.[39] In the decades following the Civil War, the central figure in many of the proposals to help New

Orleans was Capt. Charles W. Howell. This officer, born in Indiana and possessing an excellent record with the Army of the Potomac during the Civil War, apparently came to identify to a surprising degree with the interests of New Orleans. He enjoyed strong local support for his planned St. Philip Canal, and was joined by local businessmen in his opposition to Eads' jetties. In this, as in many other ways, this officer whose life was short and whose projects by and large were unsuccessful, was a key figure in his efforts to improve the network of trade at New Orleans and throughout Louisiana.[40]

His experiments with mattress revetment to protect the Port of New Orleans are another case in point. The use of "a revetment of brush and stone in such shapes and forms as best suited the particular locality" had been recommended by a Board of Engineers convened in 1878 at the request of the New Orleans city council "to examine and report upon the means necessary to protect the wharves and harbor from the incursions of the river."[41] This board evidently saw the "brush matting" being made in immense continuous carpets 200 feet wide and from 2,000 to 9,200 feet long. An act of 18 June 1878 appropriated $50,000 to commence the work.[42] In his report of 30 September 1879, Howell described his experiments with mattresses of "fishpole" cane, which he attached to pilings and sank with a ballast of "worn-out boiler-tubes filled with sand."[43] He admitted that he was "not prepared to venture an opinion as to the permanence of the work," and in fact the cane mattresses proved too frail for the swift current complicated by the traffic of a busy port. The experiment was given up within a few years, and the reorganization of 1882 saw the Port of New Orleans, along with Vicksburg and Natchez, turned over to the Fourth District of the Mississippi River Commission.[44] In this attempt as in so many others, Howell saw an interesting beginning fade into ultimate failure.

The Commission which took over his work viewed its job entirely in terms of the river — of maintaining navigation and protecting the banks against undermining. It declined to aid the Orleans Levee Board in maintaining its levees at New Orleans. Construction and maintenance remained a local responsibility, since the valuable city property provided the Orleans Levee Board something rare in the experience of levee districts — an adequate tax base.[45] The Commission concentrated its efforts on protecting the concave bends of the river, where erosion was the worst. New Orleans had more than its share of these bends: it is not called the Crescent City for nothing. Moving downstream, the current of the river struck the east bank of the Carrollton Bend above the city. Then it crossed to the west bank of the Greenville Bend opposite Audubon Park, where the Ames crevasse occurred in 1891. The west bank of the Gouldsboro Bend at Gretna was the next spot of attack, and then the current recrossed to strike the east bank again along "downtown" New Orleans at the place called the Third District Reach. Between Gretna on the west bank and the Third District Reach across the river, the Algiers Point juts out, an area of heavy current attack where the land "does not wear away little by little, but at intervals of years caves away in large masses, destroying an acre or two . . . at a time."[46]

To protect the port the Commission brought to bear the new techniques that it was developing for the river as a whole. In 1884 the building of spur dikes protected by willow-mattress revetment was begun.[47] During the low-water season of 1896-1897 Capt. George McClellan Derby of the Fourth District began the practice of making the mats at the site where willows were obtained, and then towing them into place. This became standard practice in the Fourth District, since

the size of the river made it possible to tow the mats at low water, when the current was not unmanageably swift. The development of this means of protection for the port of New Orleans is, however, primarily a story of the evolving technology of bank revetment, which has been told elsewhere.[48] Modern projects of bank stabilization and channel maintenance are no more than extensions of the plans developed by Howell and the Mississippi River Commission, though geared to modern needs and utilizing modern techniques. Today dredging maintains a 40-foot channel in the Mississippi below Baton Rouge, and the articulated concrete mat has replaced the willow mattress for protecting and stabilizing the banks.[49] However, these works are no longer the whole story of Engineer contributions to the port of New Orleans.

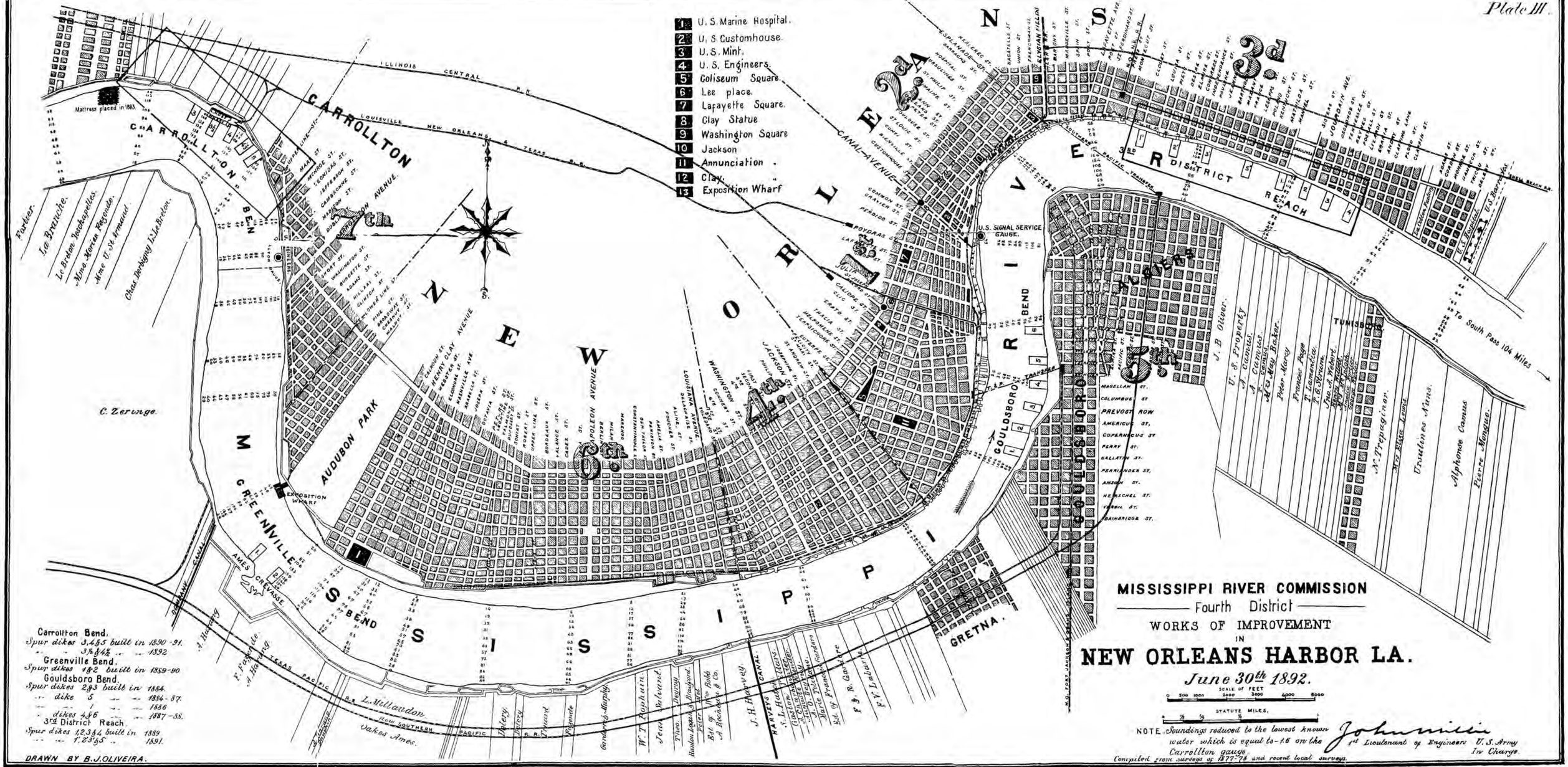
Until very recently the job of developing the artificial, slack-water port desired by the city was done by local interests alone. New Orleans has suffered as well as benefited from its dependence on the Mississippi. Its wharf facilities rested on the bank of an alluvial river, and the traffic of the port made the job of stabilizing those banks exceptionally difficult. There were other difficulties as well. The deep swift-running river required an elaborate system of pilotage to bring ocean vessels safely up its winding channel against a strong current. The river's course was unstable and constantly shifting near its mouths, and provided a route to the city that was long, slow, and indirect. When air warmed by contact with the Gulf touched the cold river water, dense low-lying fogs developed. Especially during spring and fall the levees defined a river of mist, even on days and nights which were otherwise clear. New Orleans businessmen understandably wanted to be free from complete dependence on a powerful and whimsical river. They dreamed of creating a slack-water port with straight-line access to the Gulf, whose water, entering from the Gulf, would be warm and relatively fog-free.[50]

But efforts by the city to have the Federal Government undertake the construction of an artificial port were long viewed with disfavor at Washington. New Orleans' viewpoint was that, as entrepot of the Mississippi Valley, its development would bring advantages to the nation as a whole. Other parts of the country took a less favorable view, while not, of course, neglecting to seek similar justifications for their own favorite projects. In the end, some imaginative work at the local level, the economic development of the Gulf region, and the increasing power of the Louisiana Congressional delegation were required to bring the Engineers into the project.

During the twentieth century an imaginative plan was undertaken by the Board of Commissioners for the Port of New Orleans, an agency of the state of Louisiana that is generally called the "Dock Board." Ownership and operation of most of the port's terminal facilities were brought under this public body, while the Public Belt Railroad was created by the municipality to connect the wharf facilities with the twelve railroad trunk lines which had reached New Orleans. The Dock Board constructed an Inner Harbor Navigation Canal (the "Industrial Canal") at a cost of $18 million, fulfilling schemes as old as the city by providing a 5.5-mile waterway connection between the river and Lake Pontchartrain. In all of these significant developments the Federal Government had no part, though the First World War brought a $15 million Army Supply Base to the inner harbor. The work of the Mississippi River Commission was essential to the old riverside port, as Mayor Martin Behrman acknowledged. But the inner port was the work of locak enterprise.[51]

A new departure began with an attempt by local interests to recover the money they had invested in the Industrial Canal by having the

Plate III.



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Federal Government take it over as part of the inland waterway system. The Corps of Engineers was cool to the idea. The River and Harbor Act of 1920 required a survey to be made of "Mississippi River, Louisiana, with a view to securing an outlet to deep water in the Gulf of Mexico by the most practicable route for a permanent channel of a depth not exceeding thirty-five feet." [52] The Corps declined to recommend such a channel, since the river already provided adequate facilities for deep-draft vessels.[53] In 1929 a House committee asked the Board of Engineers for Rivers and Harbors to investigate the possibility of the Federal Government taking over the Industrial Canal. The New Orleans District Engineer found "no necessity for an auxiliary route between the Mississippi River at New Orleans and the Gulf," though he did find some merit in the idea of including the Industrial Canal in the inland waterway system. He believed instead that dependable channels could be maintained indefinitely through the mouths of the Mississippi.[54] In effect the Corps of Engineers had come around to Eads' position, while New Orleans still pressed, apparently with little hope, for an artificial means of circumventing as much of the river route as possible.

Under the circumstances, these early attempts could only end in one way. Maj. Gen. Lytle Brown, the Chief of Engineers, concluded that no action should be taken on the various proposals that New Orleans interests had pressed through the House Committee on Rivers and Harbors.[55] The reader will note, of course, that three separate proposals were involved: first, that the Federal Government should recompense the builders of the Industrial Canal; second, that the canal should be made a part of the inalnd waterways system; third, that some sort of artificial channel should be built to give New Orleans a more dependable and shorter route to the sea. The first of these was a forlorn hope. The last two were to be essential elements in the creation of an inner port.

The eastern leg of the Intracoastal Waterway was first routed through the Industrial Canal (the state, however, maintaining ownership) and via Lake Pontchartrain to the Mississippi Sound. In 1942, anxious over the submarine menace, Congress provided instead for a land cut through the marsh from the Rigolets to a point on the canal about 2.25 miles from the Mississippi River. The passage through the lake, five drawbridges, and about 31 miles were eliminated from the Intracoastal Waterway by this route.[56] The concept of the river-Gulf outlet now took a different turn. A House committee requested a new report on a Mississippi-Gulf Outlet on 5 May 1943 — a request which the Senate Committee on Commerce had already made a few weeks earlier. The investigation was authorized by the River and Harbor Act of 1945, and was undertaken at a leisurely pace: completed 3 years later, the report was not transmitted to Congress until 25 September 1951.[57] The report was most important because it showed the river-Gulf outlet in the form it would eventually assume — jutting out of the eastern Intracoastal Waterway and running southeast into the Gulf of Mexico across the intervening marshlands. (An alternative route from the west bank direct to the Gulf was rejected when the Dock Board proposed to invest $30 million to develop port facilities along the east bank route.) A new lock and cut providing entry from the river in St. Bernard Parish was also shown — a proposal which is still a matter of controversy at this writing. The linkage of the river, the Industrial Canal, the Intracoastal Waterway, and the Mississippi-Gulf outlet emerged as a mature concept, which, if fully implemented, would make New Orleans quite a different kind of port from the one it had been throughout its history. And quite a different kind of city, too, since trade, in-

dustry, and settlement would inevitably move toward the hitherto waste lands east of the present city to cluster around the new connections to the sea.

Nevertheless the costs were shown to be high and the benefits of the outlet somewhat speculative. An initial investment of $67 million at 1948 prices would be required, with annual maintenance estimated at $4 million. Practically the whole direct cost would be borne by the Federal Government, though very broad commitments would be required from local interests toward the indirect costs associated with the outlet.[58] In its review, the Bureau of the Budget found that the channel could not be justified, considered by itself; rather, the benefits to be derived from the expansion of port facilities around the turning basin included as part of the project represented the only substantial savings to commerce. The ship channel could be justified in terms of what is now called "centroport" feature alone. Taken together, the channel-and-turning basin constituted "valuable long-range improvements . . . to be undertaken as conditions permit." However, no appropriation was to be sought "until such time as the budgetary situation makes possible the initiation of such improvements."[59]

In plain fact, this qualified endorsement meant that not enough political steam had gathered behind the Gulf outlet. Costs were high, and whatever the country might gain indirectly by building New Orleans a slack-water outlet to the sea, the immediate and tangible benefits would accrue to local interests alone. The Louisiana Congressional delegation argued that the expansion of water commerce using New Orleans was steady and was likely to continue; that New Orleans, alone of American ports, served a hinterland of indefinite extent; and that the systematic development of the Mississippi and its tributaries logically demanded an equal development for the entrepot of the whole valley.[60] These arguments gained strength during the early years of the Eisenhower administration. The end of the Korean War, the growing strength of the Louisiana delegation, and the precedent established by the heavy Federal investment in the St. Lawrence Seaway all contributed, directly or indirectly, to the eventual success of the proposal.

The 1950's became a time of heavy investment in the national transportation system. The Interstate Highway System was approved as well as the St. Lawrence Seaway. The Mississippi-Gulf outlet, so significant locally, was a small part of the far-reaching developments in road, water, and air transport that characterized the time. Backing for the project became increasingly well organized and powerful. The New Orleans Public Service, the Dock Board, and private transportation interests developed an effective spokesman in the Tidewater Development Association. Endorsement of the outlet was secured from eleven governors in the primary trade area of the Mississippi Valley. Strong backing and a favorable atmosphere resulted at last in the authorization of the Mississippi-Gulf Outlet in the River and Harbor Act of 1956.[61] In terms of the overall trade pattern of the Mississippi Valley and the Intracoastal Waterway, the development of new facilities geared to the waterway at New Orleans — the point of intersection of the T — was probably to be expected, and is almost certain to be justified by the overall growth of the region which it serves.

A summary of the Gulf outlet would indicate that the channel fulfills an old need of the city of New Orleans for a slack-water port; that any adverse effects are relatively slight and can be mitigated; and that the strategic location of the city in turn guarantees that the benefits of its expansion will be spread far beyond local limits. However, the possibilities of the outlet are still far from being realized. At the time of writing the

channel is still operating below its capacity, and a broad implementation of what is now called the "centroport" concept, with heavy local investment all along the artificial waterways of the inner harbor, will be necessary to fulfill the outlet's promise for the future

Up to 1912, the Annual Reports of the Chief of Engineers listed some 860-odd rivers, bayous, lakes, and passes which the District had surveyed or improved since the end of the Civil War.[62] Since the basic pattern of the T has emerged, these minor streams have acquired new meanings. Still important for local trade, they have become part of a broad pattern of regional and national commerce as well.

Some have been incorporated into the inland waterway, supplying it exits to the Gulf, opening water access to the hinterland, or providing alternate routes to major production centers like Baton Rouge. Outlets from the Intracoastal Waterway to the Gulf have been built utilizing the Mermentau River, the Calcasieu, Freshwater Bayou, Wax Lake, Bayou Lafourche, and the Lower Atchafalaya. These outlets are of great significance to the offshore oil industry, as well as to the shrimp and fishing fleets and general trade. An important recent development was the extension of the Intracoastal Waterway up the valley of the Atchafalaya by way of Grand River and land cuts to Port Allen, opposite Baton Rouge.[63] New projects involve flood protection for the Mermentau north of the waterway, while channel improvements are planned for Bayous Teche and Lafourche. But the most extensive and complex work on the smaller streams is that undertaken on the Calcasieu River, of which the rapidly expanding city of Lake Charles has been the principal beneficiary.

The Calcasieu is a small river running roughly parallel to the Mississippi in Southwestern Louisiana. Its 3500-square-mile basin is a typical mixture of low hills, prairie, and marsh. Rich oil and gas fields lie within the 100-mile curve of the upper river. Rice-lands surround the city of Lake Charles, a boomtown of a quarter-million population which lies 34 miles from the Gulf just south of the point where the West Fork enters the mainstream of the Calcasieu. On its own scale the growth of the Louisiana port has been as remarkable as that of Houston: Lake Charles, which had 16,000 inhabitants in 1930, had more than twelve times as many thirty years later.[64] If New Orleans had experienced similar growth, it would today be larger than Chicago.

The key to this growth has been the natural wealth of the region and the opening of a complex of water links to the ocean, the Gulf coast, and the Mississippi in which local interests and the Engineers have both had a hand. From 1872 on, the New Orleans District maintained a program of snagging and dredging on the Calcasieu.[65] However, the river was unable even when cleared of obstructions to serve as an efficient route to the Gulf, for it flows, south of Lake Charles, into Calcasieu Lake, which is only 5 to 6 feet deep, and thence by a pass into the Gulf. To answer the problem, the Parish of Calcasieu undertook to build a deepwater canal to the more navigable Sabine River, which runs parallel to the Calcasieu on the western border of Louisiana. By 1926 this canal was functioning, making Lake Charles a deepwater port; later the canal was absorbed into the western Intracoastal Waterway, which gradually made Lake Charles the regional market for a broad arc of rich Gulf lands. In 1937 a program of improvement was proposed by the Engineers to make the Calcasieu useful for commerce.[66] Approved by Congress, the work was begun by the New Orleans District in 1941.[67] A 40- by 400-foot channel was dredged from old Highway 90 at Lake Charles to the Gulf, where existing jetties

were enlarged and straightened to enable the channel to maintain itself. An approach channel from the Gulf of Mexico was also opened, to provide ready access to deep water. Further provisions were made for constructing a mooring and turning basin, a ship channel to Cameron, and a salt water guard lock at the intersection of the river and the Intracoastal Waterway.[68] These water links were the key to the Lake Charles phenomenon, and the regional growth and development that followed were a fair — though very spectacular — example of what has happened elsewhere along the waterway.

The New Orleans District has materially assisted regional economic development by constructing the Intracoastal Waterway and by aiding the expansion of the Port of New Orleans. The growth of trade along waterway and river, with its hub at New Orleans, in turn, has encouraged the development of many smaller waterways throughout the Gulf region. In Louisiana this development of the smaller streams has been especially noteworthy. No other state has so many miles of waterways. If undeveloped, they are mere obstructions to road and rail; if cleared, dredged, and connected with markets, they become highways instead of barriers for economic growth and social development. The overall benefits of this growth would be disputed by few human beings. Everywhere along the T of trade, isolated communities scarred by poverty and ignorance have been brought — literally — into the mainstream of American life.

But success brings its own problems. In their undeveloped state, the bayous of Louisiana preserved a rich regional culture as well as regions of desperate rural poverty and ignorance. Game preserves and areas of unique and exotic natural beauty are no longer protected by their remoteness. "Crossing the T" has helped to bring the New Orleans District face to face with the newest problem of all — to integrate future patterns of economic development with the preservation of traditional human and natural resources.

The reorganization of 1928 had brought no more than a change of names to the Engineers at New Orleans. The old Engineer District became the First New Orleans District, while the Fourth District of the Mississippi River Commission, after a brief rechristening as the New Orleans River District, became the Second.[1] In 1940, however, a decisive administrative change occurred when the Gulf Division was abolished and the First and Second New Orleans Districts were united.[2] The new organization, occupying the Second District complex at Prytania Street and the river, was placed entirely under the Lower Mississippi Valley Division Engineer at Vicksburg. The only trace of the old division of duties survived in the "two hats" worn by the Division Engineer. Henceforth projects dealing with the river were submitted to him as President of the Mississippi River Commission, while projects not connected with the river were submitted to the same officer in his capacity as Division Engineer. This setup survives to the present day.

The unified command was tested almost at once in military construction work during the Second World War, and subsequently in a broad and ever-expanding program of civil works. Today the District is one of the most important in the nation, with a total backlog of authorized work amounting to $2.4 billion. Its importance to the state and region it serves has likewise grown. The last generation has seen the South as a whole finally throw off the effects of the Civil War and begin a rapid development similar to that which the Northeast underwent generations ago. The District has played a major role in this period of economic change, and seems likely to play an even bigger one in the future. As in the past, the nature of the Delta landscape gives an agency that deals with waterways a unique importance in the growth of Louisiana.

No other state possesses so great a proportion of water to land, and in no other is the rational development of that water so significant. Though the state is small, its economy is large and growing. Already it produces 20 percent of the nation's crude petroleum, 27 percent of its natural gas, 50 percent of its sulfur, and 24 percent of its salt. The state harvests sugar and rice from its fields, and fur from its marshes. It possesses surprising resources, not only in its rich wildlife habitat, but in its cultural variety, the pockets of French language and customs which enrich the human environment of the state and the nation. What is done with the state's waterways will shape the pattern of economic development, which, in turn, will affect everything else.

Finally, the national movement to conserve the natural environment has come upon the scene. Nationally, Corps and country are in the process of redefining the goals of the civil works program. All these changes signal new directions and heavier duties for the unified New Orleans District.

The period of the Second World War was a difficult one for the District. Many of its key personnel were called to active military service; many were reserve officers with the 337th Engineer Battalion. The depleted District was left to carry on its usual heavy responsibilities, including two major floodfights in 1944 and 1945, the second of which required the opening of the Bonnet Carre Spillway.[3] For nearly two years (January 1941 to December 1942) it carried on an extensive program of military construction as well.[4] Airbases, camps, an ordnance backup depot, seacoast fortifications, a wharf and engineer depot, and the construction of oil and cargo barges to speed the delivery of war materiel to the eastern seaboard — all added

to the work of the depleted District. Much credit for bringing it through the wartime successfully must be given to George H. Hudson, a civilian member of the District and an officer of the Army Reserve, who was made District Engineer during the war, and to a group of old-line civilian employees who were not affected by the draft.[5]

As wartime troubles faded, the District built up its depleted ranks; many of its former employees returned from active service, and the customary civil works program was resumed. Ten years after the end of the war, however, a distinctly new type of duty emerged for the District as the Federal Government, for the first time, began to give the Corps broad responsibilities in the field of hurricane control.[6]

In a way it is surprising that hurricanes have only recently become a concern of the New Orleans District. The great equinoctial storms have been one of the oldest and most difficult problems of the American Gulf Coast. The latitude and concave shape of the coast have always made it a natural trap for tropical storms arising in the warm seas to the south. From the tempest of 19 September 1559 — the first tropical storm of record in the Gulf — to Hurricane "Camille" in August 1969, coastal Louisiana has been struck or threatened by about 160 hurricanes in 410 years.[7] The storms have seriously affected the development of the coast, killing people and animals, destroying homes and businesses, ruining crops, and changing the ecology and even the topography of the land. As cities grew, they proved to be especially vulnerable. Their protective levees have been damaged, their communications destroyed, their dense populations endangered by wind and water, and, in the aftermath of great storms, intolerable burdens placed on every form of community service.

Pending development of an effective means for aborting hurricanes (perhaps by "seeding" them at an early stage of growth) more traditional remedies will have to be applied to the troubles brought by the big ill winds. The basic resource still lies in the people of the region, where long experience, a tradition of mutual assistance, and an increasingly effective warning service have made for survival and rapid recovery after all but the worst storms. Federal assistance for the people caught in these and other disasters began in the 1950's.[8] As part of a comprehensive scheme of help coordinated by the Office of Emergency Planning, the local districts of the Corps were assigned work appropriate to their special skills. They were to supply the defensive works — mainly locks and levees — to protect the land, and, once a storm had passed, to carry out the immense cleanup job that followed.

After the storms of 1954 had severely damaged the Atlantic Coast, Congress instructed the Chief of Engineers to begin surveys for the protective works that would be needed in areas endangered by hurricanes. The New Orleans District undertook to plan a "Lake Pontchartrain and Vicinity Protection Project," embodying a scientific study of the region and outlining the works that would be necessary to protect it from future storms. Turning to new account the skills they had learned in dealing with floods, the Engineers charged with the project established two hurricanes to serve as standards — in effect, to play the role that the Project Flood played in the Jadwin Plan. The first of these projected storms (the Standard Project Hurricane) was, in terms of intensity and path, the most severe storm *likely* to occur in the region; the second (the Probable Maximum Hurricane) was the worst storm assumed to be *possible* in the region. Lacking any means of protecting against the winds (only a comprehensive reform of local building codes could be of much value here) the District concentrated on guarding against the hurricane surge or "storm

tide" from the Gulf of Mexico. Since most loss of life has resulted from these surges, to which the flat coastline offers no obstacle, the District was aiming at a critical point in the work of storm control.[9]

The Standard Project Hurricane critical to New Orleans would approach from the south, come inland west of the Mississippi's mouth, and curve eastward over Lake Borgne. With a central pressure of 27.6 inches of mercury and a maximum wind velocity of 100 miles per hour at a radius of 30 miles, this hurricane would inundate about 700,000 acres with depths up to 16 feet. Though about 240,000 acres were marshland east of the city, the District's plan warned that the 460,000 acres remaining included "a major part of metropolitan New Orleans."[10] This grave warning was borne out when, on 9 September 1965, Hurricane "Betsy" struck New Orleans. With higher winds than the Standard Project Hurricane, but describing a path that lacked the ominous eastward curve over Lake Borgne, the storm inundated 531,000 acres in the four-parish New Orleans Metropolitan area. Seventy-nine deaths and a half-billion dollars in property damage wrote a grim endorsement to the hurricane protection plan. Above all the need had been demonstrated for protection against the storm tide, the principal instrument of death wielded by "Betsy."

Congress quickly enacted the District's plan as part of the Flood Control Act of October 1965.[11] The work of construction, now underway, will eventually provide the city with the same protection against storm surges that it now has against floods from the Mississippi. A new levee will protect the south shore of Lake Pontchartrain from Bonnet Carre Spillway to South Point. Steel and concrete floodways along the Industrial Canal, levees along the north side of the Intracoastal Waterway, and a connecting link roughly parallel to Highway 11 will protect the developing area called New Orleans East. Storm tides will be checked from entering th lake by a lock and control structure at the Rigolets, and a floodgate and control structure at Chef Menteur. Another structure at Seabrook on the lakefront will not only help to check hurricane surge, but will protect the valuable Pontchartrain fishing grounds from changes in the salinity gradient caused by salt water intrusion. South of the Intracoastal Waterway and west of the Gulf Outlet another ring of levees and floodwalls will enclose the heavily settled suburbs of St. Bernard Parish and the lower Ninth Ward of New Orleans, where the storm tide of 1965 did its worst work of destruction. Finally, a floodwall west of the Industrial Canal is to prevent any possible danger to the central city.

The city of New Orleans, however, is not the only area which the Corps must protect. South Louisiana has many rich and vulnerable regions, and the aim of the hurricane protection plan is to safeguard as many of them as possible. Settled areas near Franklin and Morgan City, and in the vicinity of Golden Meadwo, need and will receive additional protection. The lower coast of the Mississippi River below New Orleans will be protected under the New Orleans to Venice Hurricane Protection Project. This region is second only to New Orleans in the damages which it has received from recent hurricanes. Here losses from Hurricane "Betsy" reached $50 million, and those from "Camille" in 1969, $100 million. Not only are important industries growing in the region, but the service industries for offshore oil development will shortly represent an investment in excess of $1 billion. Rich, vulnerable, and often attacked by hurricanes, the protection of this region is one of the most pressing duties of the New Orleans District.[12]

Aside from structural works, the District has also taken part in the work of saving life and property during storms, and cleaning up

the wreckage afterward. These jobs have developed informally as a result of certain laws [13] and regulations of the Corps of Engineers [14] adopted over the past 15 years. Priorities established by these laws require local Division and District Engineers to give first attention to the Corps's own flood control works and other facilities; next, to furnish technical assistance to local authorities in protecting Federal works which they maintain; finally, to give direct aid to rescue and supply operations when the local powers "have committed their resources, or are unable to cope with the flood or coastal storm situations." [15] Division Engineers are authorized to call upon other elements of the armed forces for emergency support.[16] Liaison is maintained with the Office of Civil Defense and the Office of Emergency Planning, the Red Cross, and local interests. After the emergency has passed, the Corps — in the event that the President proclaims a major disaster — may be authorized by the Office of Emergency Planning to survey damage, perform emergency channel clearance and shore protection, clear wreckage and debris, and repair or replace public facilities on an emergency basis.[17] In practice, however, the books have been shelved in actual emergencies and a rapid and informal allocation of men and machines has been made wherever the need was greatest. For example, while the official schedule was followed during Hurricane "Betsy", Government property was so rapidly secured that Corps personnel and boats were the first to enter the flooded areas near the Industrial Canal and begin rescue operations there.[18]

Cleaning up the wreckage after the storm is the last part of the Corps program. The breakdown in transport and communication needs quick attention. Restoring freedom of movement and an orderly appearance to a stricken city are essential, both to make police protection effective and to restore citizen morale. In this work — especially after "Betsy" and "Camille" — the District has contributed equipment and skilled personnel to the massive cooperative effort in which official agencies and citizen volunteers alike take part. Special problems requiring a high degree of specialized skill and large, sophisticated equipment — clearing roads blocked by boats and houses, or refloating massive barges carried inland by the hurricane surge — particularly require the professionalism of the Corps. In the still unsolved problem of the hurricanes, the New Orleans District has become one of the most important of the many allies who fight the battle together.[19]

Important as the hurricane protection program is — and in terms of saving human lives it is undoubtedly the most important new program of the District — it is, in one sense, traditional in nature. It is essentially a flood-fight against salt water instead of fresh. Oddly enough, it is in the field of river development — in the ancient, basic problems of dealing with alluvial streams — that the boldest new programs of the District are taking place. In the field of comprehensive basin development, new ideas which are currently transforming the Corps and the country impinge directly on the work of the New Orleans District.

As now constituted, the District bears responsibility not for one great alluvial river but for two. The Red River, a major tributary of the Mississippi some 1200 miles in length, has had a complex history since the Civil War. The part of the river that lies within Louisiana was assigned to the New Orleans Engineer Office under Maj. Charles W. Howell, transferred to the Memphis Office when Maj. W. H. H. Benyaurd was in charge, later to Vicksburg, and finally back to New Orleans. Today the New Orleans District bears responsibility for the river south of Fulton, Arkansas. Whoever has had the job of dealing with the

Red has found it a baffling problem — all the more so because its valley has always promised rich returns in human use and enjoyment, promises which the erratic stream has always prevented from maturing.

The basic difficulties of the Red are the typical troubles of an alluvial stream, complicated by its erratic flow and the sandy soil of its flood plain. Typically its valley experiences heavy spring rains, while precipitation is very light for the rest of the year. (This pattern is particularly noticeable toward the western end of the valley.) Thus a pattern of floodwater followed by low water is established, with high water generally coming at a time when it is least useful in moving agricultural products to market. Add these factors together and most of the troubles of the Red can be understood. Spring floods undermine the banks and saturate the soil. When the river falls, the weakened banks collapse into the channel. Erosion encourages shoaling. The river, so lately a torrent, is now so shallow that motorboats can scarcely maneuver in some reaches. And the caving of forested banks has added another mass of dying snags to the stream, which the next high water will carry down — perhaps to form a raft.[20]

If the fact were not attested by hundreds of contemporary accounts, the extent of the Red River rafts of bygone days would be almost unbelievable. At its greatest extent in 1828 the Great Raft of the Red was 92 miles in length, extending from Loggy Bayou, 65 miles below the present site of Shreveport, to Hurricane Bluffs, 27 miles above.[21] With the tools of the time, cutting through solid rock would have been an easy task compared with opening a way through this tough, resilient, matted obstacle that grew with the timber brought down by every high water. However, the raft was successfully attacked by Capt. Henry Miller Shreve. As Superintendent of Improvements on the western rivers Shreve broke through the lower sections of the raft and established Shreve's Landing (later Shreveport) in 1835.[22] However, the raft periodically re-formed, and between 1828 and 1841 the United States spent over $425,000 for its removal. The decline in Federally financed internal improvements interrupted the work, and appropriations failed between 1841 and 1852. During the brief revival of civil works activities in that year, another $100,000 was appropriated, and the way to Shreveport was reopened. The supply of funds then failed once more, in typical antebellum fashion, and the troubles of Civil War and Reconstruction had to pass before work could be resumed. New appropriations at last were made in 1872, but when Federal work resumed, the years of neglect and war had left their mark.

> . . . the river above Shreveport, La., was closed by a raft 32 miles long, and growing constantly. Below Shreveport the enlargement of an outlet through Tones Bayou was depleting the main channel and threatening its closure to navigation. At Alexandria, La., the falls were impassible at low stages. Navigation was difficult and dangerous at all places and at all times. The channel shifted frequently, and at flood the river overflowed the entire raft region. The banks were heavily timbered and each flood caused them to cave or slide.[23]

In the face of so many difficulties, the Engineers at first set about securing an effective channel for navigation. The whole economy of the region beyond Shreveport had been transformed by the raft, sometimes in surprising ways. Though the effect on the normal traffic of the river was adverse, the blockage of water had raised the bayous leading into the Red from eastern Texas. A brisk local trade had sprung up along these bayous, and the cotton of Texas found a way to market at New Orleans by the devious streams that paralleled the Red. Ironically, clearing the main river caused the water in

these streams to fall, cutting off the trade, which then shifted to St. Louis by a spur railroad. It is not surprising that the Engineer in charge of the work recommended "Fabian tactics" in clearing the river and reported the destruction of at least one dam by "a body of masked men." [24]

Despite everything, small but regular appropriations enabled a gradual improvement to take place. The raft was broken in 1873 and the major outlets gradually closed off. Scour increased, the channel deepened, and the perils of navigation, which had claimed nearly 200 steamboats up to 1887, steadily lessened.[25] To prevent new snags from getting into the channel, banks were cleared and the worst shoals were dredged. Efforts were begun to stop bank erosion by wing dams and revetment.[26] A period of optimism over the river's future followed. In 1909, the Vicksburg Engineer Office reported that at high water the river was navigable as far as Denison, Texas — 800 miles above the Atchafalaya junction. Between 1890 and 1909 considerable traffic moved on the Red, mostly agricultural and timber products with estimated values ranging from $1.5 to $9 million a year. It is doubtful that the Red has moved equivalent cargo values since that time.

The trouble was that commerce on the Red had never been more than a *tour de force.* Commerce moved on the Red in spite of the river. The limited improvements which were possible under the small appropriations then available — and under the narrow conceptions then current of what constituted "improvement" — were just not enough to cure the basic difficulties intrinsic in the nature of the river and of its valley. It is not surprising that railroad competition was successful in taking over the commerce of the region — and that, in contrast to the Mississippi, when commerce abandoned the Red it abandoned the river for good. In 1908 a decline was noted in the value of waterborne cargo,[27] and from that time on river trade fell precipitously until revived by the First World War.[28] Still, average commerce during the war years was only about half that of 1890-1908.[29] If river commerce was to revive permanently — and it was important that it should, since the land along its banks produced the sort of bulk products which were best adapted for water transport — a whole new approach to the problem of the river must be made.

This need was underlined by the lagging social and economic development of the valley. A century ago the basin of the Red was sparsely inhabited, with not one town of 5000 inhabitants. Development after the Civil War was mainly directed to opening land for cotton production, which, by the twentieth century, had begun to produce destructive side effects in soil depletion and erosion. Then discovery of oil began to push the region toward a more diversified economy, and today manufacturing, trade and services employ more workers than agriculture. Yet the valley remains essentially underdeveloped. The average per capita income of its people was 40 percent below the national average in 1960. The comprehensive report prepared in 1968 by the Red River Basin Coordinating Committee concluded that "the basin lacks the diversity and industrial base required to insure resaonable progress in closing the economic gap." [30]

The modern efforts of the Federal Government to assist the development of the Red have been varied and complex. The Flood Control Act of 1946 authorized, among other work, the construction of reservoirs and tributaries of the Red. Two of these, Lake Texarkana and Lake O' the Pines, have subsequently developed, not only as flood control projects, but as prime recreation areas for the "ArkLaTex" region which includes the cities of Shreveport and Dallas-Fort Worth. The most important new concept for dealing with the Red, however, began during

the 1950's, when the approach called comprehensive basin planning began to be applied to the region. This concept first appeared in Federal law in the Flood Control Act of 1950. In that law Congress demanded a survey of the Arkansas-White-Red River systems

> . . . with a view to developing comprehensive, integrated plans of improvement for navigation, flood control, domestic and municipal water supplies, reclamation and irrigation, development and utilization of hydroelectric power, conservation of soil, forest and wildlife resources including such consideration of recreation uses, salinity and sediment control, and pollution abatement as may be provided for under Federal policies and procedures, all to be coordinated with the Department of the Interior, the Department of Agriculture, and Federal Power Commission, other appropriate Federal agencies and with the States, as required by existing law .[31]

Not only did this law sketch out the dimensions of comprehensive planning, it implied the means by which it was to be carried out — by mixed committees representing the Federal agencies and the states involved in each proposal. As a rule these committees have met under the chairmanship of a District or Division Engineer.

The study of the vast area of the Arkansas-White-Red River basins was undertaken by a committee representing seven Federal agencies and eight states.[32] Naturally such a body was troubled by dissensions among the states, which had quite different interests, and by jurisdictional problems among the Federal agencies. Despite an enormous amount of pioneering effort, no unified plan could be developed for the whole area, and separate plans for the Arkansas-White and the Red River basins were ultimately drawn up. The present plan for the Red River below Denison Dam was developed by a coordinating committee which represented four states (Louisiana, Texas, Arkansas, and Oklahoma) and six Federal agencies. The New Orleans District Engineer, Col. Thomas J. Bowen, was chairman of the joint effort. An interim report on navigation and bank stabilization was submitted in 1966, and in 1968 a classic eight-volume study put forward a plan for the transformation of the Red River Valley.[33]

The plan was shaped by the history of the Red. Navigation and bank stabilization were given first priority, followed by the "control of damaging floodflows through reservoir storage or channel improvement." The basic economic goals were to assure a dependable and plentiful flow of water, to end destruction of farm and forest land by the undermining of banks, and to open a channel for barge commerce that would serve, not only for transportation but as a basis for the growth of industry and recreation in the region as a whole. A waterway was to be opened, 9 feet deep and 200 feet wide, from Old River Junction to Daingerfield, Texas. The waterway was to follow, generally speaking, the existing channel of the Red, which, however, was to be straightened and shortened by the creation of 46 cutoffs. Beyond Shreveport, the channel was to cut through Twelvemile and Cypress Bayous to a turning basin in Lake O' the Pines near Daingerfield.[34] Nine lock and dam combinations were planned along the channel to secure navigational depths.[35] The cutoff sections of the river would, of course, form oxbow lakes which experience has shown to be excellent fishing and recreational grounds. The cost of the program as a whole is presently estimated at $751 million, about 95 percent of which is to be provided by the Federal Government.

The projects for dealing with the Red are now so numerous and complex that there is a great difficulty even in describing them. In addition to the features built before the

comprehensive study was made, the opening of a waterway through the first 31 miles of the river above Old River has been undertaken under plans projected in the interim report on navigation and bank stabilization. Fourteen million dollars has been expended for work on bank stabilization and levees between Index, Arkansas and Alexandria, Louisiana — a feature of the work being that each item of bank stabilization must be shown to be less costly than a levee setback in the same location. As a result, "the [Red River] levees," as the New Orleans District Engineer reported in October 1970, "are substantially complete." [36] Emergency bank protection at critical areas has been funded under another project, and still another has provided $22 million (of which about $9 million has actually been spent) for the enlargement and protection of the levee along the south bank of the Red from Boyce to Moncla, Louisiana.

The program as a whole, however, can only proceed gradually until the winding down of the Vietnam war and the cooling of inflation bring higher priorities to peaceful development. The construction of the first navigation dam on the mainline of the Red is not planned until 1974, and the completion of the waterway, some 274 miles in length, will take approximately 12 to 16 years.[37] This would be in line with the development of the Arkansas, which required 20 years for completion, with 4 years of interrupted appropriations to delay it.

Overall, the Red River Waterway project, when complete, will be the biggest single civil works project in the history of the New Orleans District. Since the Red is the last major American river basin to undergo development, the experience of the past will be available to provide hints and to warn of dangers. When complete, the project will hold out a promise of a new and more prosperous environment into which people and industry will flow, while preserving wild areas and providing the recreation that is essential to a full human life. Of all the forms of transport, only the waterway can improve life in so many different ways — and encourage other forms of transportation as well, since road, rail, and air transport follow the movement of people and industry to a newly developed area. This is the promise of the Red, and Captain Shreve himself might approve the bigness and boldness of the project for the final disciplining of his vagrant, hopeful, obstreperous river.

The case of the Red River points up many of the new currents in national life which are beginning to affect the work of the New Orleans District. Comprehensive basin planning cannot be understood only in economic terms. It has long-range demographic goals which can best be seen in light of the current national concern with the decentralization of American life. Notoriously, the basic pattern of change in the United States during the past century has been one of intensifying settlement in a few highly-industralized areas. Lack of jobs in rural regions has led to the depopulation of the land as fewer and fewer hands were required to produce greater quantities of food. But the heavy settlement in urban areas has placed intolerable burdens on public services and degraded the quality of life for the people who live there. Throughout the country there has been a failure to achieve the reasonable balance between industry and agriculture, wild and settled land, work and recreation areas that makes for a satisfactory human life.

The basic importance of comprehensive basin planning is that it promises an alternative to this picture. The development of the Arkansas River, finally completed in 1969, indicated that providing cheap and efficient water transport is a genuine incentive to the settlement of industry in hitherto backward areas.[38] Ideally, the artificial lakes that form

part of river basin development will also serve as recreation areas and wild regions will be marked out and protected as part of the environmental planning. Finally, the slowing rate of increase in America's population means that the newly developed regions need not become overpopulated like the cities of today. The possibility exists for genuine, long-term redistribution of a stabilized American populace, and the emergence of a better and more human style of life in the small cities, industrial parks, farms, recreation areas, and protected forest and game reserves of the river basins. The difficulties are great — in engineering, in organization, in finance, in the plain selfishness and obstinacy of the human animal — but overall, river basin development is one of the most hopeful changes taking place in present-day America.

If such planning is to be effective, however, improved resource management and more regorous control of industrial pollution must be applied wherever development takes place. In times past the American people have automatically accepted development as a desirable goal without pausing to examine its destructive side effects or to make provision against them. Smog, congestion, and poisoned waters have drastically changed popular feeling, and it is certain that the future will be far different from the past. For the New Orleans District this change means a new urgency in many traditional programs of pollution control, though in themselves these programs are nothing new. Undesirable changes in the balance of nature may result from unforeseen accidents or the growth of private industry, and natural problems may be intensified by the growth of artificial waterways. In various ways the District has been dealing with such problems, in some cases for two generations or more.

For more than 70 years, obnoxious aquatic plants have been an obstinate problem for the New Orleans Engineer Office and its successors. The water hyacinth (*Eichhornia crassipes*), an aquatic herb native to tropical America, was evidently introduced into the United States as an ornamental plant and then "escaped from captivity." Hyacinth cover is extremely destructive to aquatic life of all kinds — it can, in fact, "produce a virtually sterile aquatic ecosystem," as a recent environmentalist study declared.[39] Despite protracted efforts by a variety of means, and an expanded control program authorized by Congress in 1959,[40] the nature of the Louisiana landscape is such that complete eradication of the plant has proved impossible, and the struggle against this and other destructive weeds has remained a yearly housekeeping chore of the New Orleans District, as unspectacular as it is essential.

The need for controlling the undesirable side effects of waterways development has long been recognized. One of the most persistent is that of salt-water intrusion through artificial waterways to the detriment of agriculture and natural ecosystems. Because of the flatness of the Delta land, salt water and fresh have always mixed to an unusual degree along the Louisiana coast. The cutting of new channels has increased a problem which is inherent in the landscape. Long before the national environmental movement was born the District was engaged in working out a solution.

The opening of the Calcasieu River and the development of Lake Charles have already been discussed in another context. When the work was done, local interests evidently foresaw that salt water would enter the rice-growing region to the north, for they specifically agreed to hold the United States free from claims for damages resulting from such intrusion. But as damage mounted over the next two decades, forcing growers to irrigate by wells or by diversion of upstream tributaries, sentiment veered around. In response to local demands, the New Orleans District

began searching for a way of meeting the problem, and in 1962 proposed a salt-water barrier which would involve closing the Calcasieu and building control and navigation facilities in an artificial channel. The program was approved by Congress without the considerable local contributions suggested by the Bureau of the Budget, and construction began in 1965. Traffic was first routed through the artificial channel on 7 September 1967,[41] and today the work provides the key to combining continued development for the Harbor of Lake Charles without destructive side effects to the region's agriculture.

A similar problem developed as a result of the Gulf-Mississippi Outlet. The opening of this channel permitted an influx of salt water into Lake Pontchartrain which threatened the salinity gradient of the lake, an important nursery area for Louisiana's fisheries. The new Seabrook complex proposed by the Engineers for the Industrial Canal includes structures designed to control this influx. The same sort of difficulty might have arisen where the Intracoastal Waterway crosses the rice-growing area of the Mermentau-Vermilion Basins. The locks on the Waterway at Calcasieu, Vermilion, Schooner Bayou, and Catfish Point are basically devices to permit navigation to continue without endangering the rice crop. When high water levels are required along the Mermentau to flood the ricefields, the locks help to retain the water. When the fresh water of the basin is higher than the Gulf, and the flooding period is ended, the locks stand open. When adverse winds pile up salt water from the Gulf and threaten to invade the basin, the locks come into operation once again, this time to keep out the salinity. Enormously busy (Calcasieu Lock passes about 42 million tons of cargo in an average year) these locks have helped to reduce salt-water intrusion, not only through the waterway, but through the natural streams of the region.[42]

Though Louisiana is not a highly industrialized state, industrial pollution is a relatively old problem. Sugar refining and petroleum production are both sources of objectionable effluents, and difficulties have repeatedly arisen in the past as a result of deliberate or accidental dumping of these and other industrial wastes into the state's waterways. The responsibilities of the New Orleans District date back to the so-called "Refuse Act" of 1899, which forbade filling, dredging, erection of structures and depositing of refuse in the navigable waters of the United States, except with the permission of the Chief of Engineers and the Secretary of the Army. To detect unlawful acts and bring charges against those responsible for them has been a duty of the District for two generations, and scores of cases have been won, either in court or by agreement with the parties responsible for specific acts forbidden by the law. Though the law was evidently framed solely with a view to preventing obstructions to navigation,[43] the District was able to prevent much industrial pollution. For example, an oil spill from Standard Oil at Baton Rouge was cited as a danger to navigation on the grounds — perfectly true — that it constituted a fire hazard; nevertheless, the effect was to reduce pollution in the affected waterway. When sugarmill effluent was polluting Bayou Teche, the Corps charged that the mill owners were obstructing navigation on a project stream by making it offensive to human use.[44] In these ways the District in fact exercised an ecological function decades before the public acquired its present interest in the preservation of the environment.

Law changed more slowly than practice, however. It was not until 1956 that Congress required the effects on fish and wildlife to be considered in the enforcement of the Refuse Act, and not until the recent National Environmental Policy Act and Federal Water Pollution Control Act that the law was

rewritten to permit the Engineers to act solely on the ground of adverse effects to the environment. Recently a suit instituted by the Corps in Florida was won in the United States Court of Appeals, the Environmental Policy Act being cited as sufficient authority for denying the permit in question.[45]

In line with these new departures, change is appearing in the District at many levels. Organizational restructuring is under consideration to provide the necessary mechanisms for giving greater weight to planning as well as to engineering. Under the Water Pollution Control Act the District is undertaking new responsibilities for preserving Louisiana's waterways. Applicants for permits to use waterways for industrial purposes will first have to meet the state's water quality standards. If state approval is secured, the District will then investigate possible obstruction to the navigability of the stream, and possible adverse effects on fish and wildlife, coordinating its work on the last question with the Interior Department. If the proposal survives a second time, it will be submitted to the Environmental Protection Agency, whose determinations are binding on the Secretary of the Army and hence on the Corps of Engineers. A permit, if finally issued, cannot be valid for longer than five years, and can be revoked at any time if violations are discovered.[46] The permit policy not only will mean cleaner waterways for the nation, but, in combination with other new developments taking place nationwide, it emphasizes the Corps' permanent, intrinsic interest in the preservation of the environment.

Thus the new duties of the New Orleans District begin to shape up. Together with the agencies of the State of Louisiana it must inaugurate a new act in the relationship between man and nature in the Delta. No other state posses so complex a pattern of waterways as Louisiana. In no other does water provide such opportunities, if developed and husbanded, or present so many obstacles and dangers, if undeveloped or misused. To find a way through the tangled political, cultural and environmental factors, to protect, develop and conserve at the same time is the unique and heavy responsibility of the evolving New Orleans District.

The District has come a long way. It began with military duties, took on civil functions, and gradually grew into the Federal agency primarily responsible for controlling and making useful the whole network of the Delta waterways. If its general course is plain, its way in detail has often meandered as intricately as the Mississippi. From the brick forts of 1803 to the pollution controversy of 1971, the District has taken on a great number of different forms, and has seen the major tides of American life, like the floods of the river, come and go. The powers of the Federal Government have grown, contracted, and grown strong again; perhaps a new era of greater local involvement is now in the offing. Whatever form the new directions of the 1970's may ultimately take, they will be reflected in the work of the Delta Engineers. Like their fellow workers elsewhere in the Corps, they deal with things that last, with the structure of the ground, the forces of flowing water, the alternations of storm and calm. Whatever changes may be in store, it is unlikely that the men and women of the District will ever find a more appropriate motto than the one they have used in the past — *Essayons*, let us try.

NOTES

INTRODUCTION

[1] Harold N. Fisk, *Geological Investigation of the Alluvial Valley of the Lower Mississippi River* (Vicksburg: Mississippi River Commission, 1944), 67-69; Robert W. Harrison, *Alluvial Empire* (Little Rock: Pioneer Press, 1961), 12.

[2] A classic study of the meander phenomenon is J. F. Friedkin, *A Laboratory Study of the Meandering of Alluvial Rivers* (Vicksburg: Waterways Experiment Station, 1945). Friedkin found that meanders develop even in a perfectly straight channel with uniform banks and unvarying flow, the sole requirement being that the banks should be susceptible to erosion. Water can carry sand only a short distance downstream. For this reason erosion produces deposition in the channel; the bar deflects the current, producing increased erosion of the bank opposite, and this in turn produces more deposition. Meander begets meander, and is propagated downstream. Consequently, too, any factor which limits erosion will limit meander.

[3] "Six . . delta complexes have been studied in lower Louisiana. From oldest to youngest, they are Bayou La Rose, Maringouin, Cocodrie, Teche, Lafourche, and Plaquemine-St. Bermard." Harold N. Fisk, *Geological Investigation of the Atchafalaya Basin and the Problem of Mississippi River Diversion* (Vicksburg: Waterways Experiment Station, 1952), 34.

[4] Lafacadio Hearn, *Chita* (New York: Harper & Brothers, 1889), 9.

[5] The drainage basin is approximately 32 percent arid, 15 percent semiarid, and 53 percent humid. *House of Representatives Document 798*, 71 Congress 3 Session (1931), 84. It ranges over 36 degrees of longitude and 21 degrees of latitude. *Ibid.* 61. These great variations in climate and aridity not only make the flooding of the river extremely variable but, as a rule, prevent the synchronization of floods in the great tributaries. When even a partial exception to the rule occurs — as in 1927 — the results are likely to be cataclysmic.

[6] "Above the mouth of Red River on the right bank, and above Baton Rouge on the left bank, the drainage of the alluvial valley finds its way through small streams and bayous into tributaries of the Mississippi River. Below these points the drainage is through numerous bayous, lakes, and streams, into the Gulf of Mexico." *Ibid.*, 67. This is not perfectly accurate (small tributaries do enter even below Baton Rouge) but it is true as regards the overall drainage pattern.

[7] Mark Twain, *Life on the Mississippi*, from *The Favorite Works of Mark Twain* (New York: Garden City, 1939), 127-128.

[8] For the purposes of this study, the following terminology will be adopted:

"Valley" means the Alluvial Valley — the Mississippi flood plain south of Cape Girardeau.

"Delta" means the deltaic plain — the part of the flood plain south of the Red River.

"Engineer" when capitalized means "an officer of the U.S. Army Corps of Engineers."

"District" when capitalized means "the New Orleans District of the Corps of Engineers."

CHAPTER ONE

[1] Maj. D. O. Elliott, *The Improvement of the Mississippi River for Flood Control and Navigation*, 2 vols. (Vicksburg: U.S. Waterways Experiment Station, 1932), II, 275. Hereafter cited as *Improvement of the Mississippi.*

[2] ". it was a beautiful thing," wrote Garciliaso de la Vega, "to look upon the sea where there had been fields, for on each side of the river the water extended over twenty leagues of land, and all this area was navigated by canoes, and nothing was seen but the top of the tallest trees." Quoted in Robert W. Harrison, *Alluvial Empire* (Little Rock: Pioneer Press, 1961), 52.

[3] M. Penicaut, *Annals of Louisiana from 1698 to 1722*, 138-139. In B. F. French, *Historical Collections of Louisiana and Florida* (New York: J. Sabin and Sons, 1869).

[4] De la Tour is supposed to have disputed Bienville's choice of a site on just these grounds.

[5] Dumont de Montigny, *History of Louisiana*, 23-24. In B. F. French, *Historical Collections of Louisiana* (New York: Lamport, Blakeman & Law, 1853).

[6] *Flood Control in the Lower Mississippi River Valley* (Vicksburg: Mississippi River Commission, 1969), 2.

[7] W. Stull Holt, *The Office of the Chief of Engineers of the Army: Its Non-Military History, Activities, and Organization* (Baltimore: The Johns Hopkins Press,1923), 1. Hereafter cited as Stull Holt, *Office of the Chief of Engineers.*

[8] *Ibid.*, 2.

[9] However, even Rensselaer did not give a civil engineering degree until 1835, and its course was limited to 1 year until 1860. See Forrest G. Hill, *Roads, Rails & Waterways: The Army Engineers in Early Transportation* (Norman: University of Oklahoma Press, 1957), 208. Hereafter cited as Hill, *Roads, Rails and Waterways.* See also Raymond H. Merritt, *Engineering in American Society* 1850-1875 (Lexington: University Press of Kentucky, 1969), 40-45. Hill emphasizes the school's limitations, Merritt its achievements.

[10] Michael Chevalier, in his *Society, Manners and Politics in the United States* (Boston: Weeks, Jordan, 1839). Quoted in Hill, *Roads, Rails and Waterways*, 4.

[11] — to Wadsworth, 10 July 1803. *Letters Sent*, II, 26, Record Group 107, National Archives. The sender was almost certainly the Secretary of War. See also —to Wadsworth, 13 February 1804, Buell Collection, Item 51, Record Group 77, National Archives. Hereafter references to this collection will be cited in the form "Buell 51 NA."

[12] Wilkinson, whose moral character is usually described as "tarnished" or dingy," indicated considerable intelligence and foresight in warning against the vulnerability of Louisiana to maritime attack. His curious "Memoir" of 27 March 1812, protested against the distrust enveloping his own reputation while putting forward a comprehensive plan for the defense of Louisiana. He recommended the seizure of Pensacola, an alliance with the Mexican revolutionists, calling out the "yeomanry" of Louisiana and the Mississippi Territory, the massing of materiel at Baton Rouge and — only 5 years after Fulton — the employment for warlike purposes of "6 Boats, to be propelled by steam." Wilkinson to Eustis, 27 March 1812, Buell 297 NA.

[13] Despite certain indications of continuing activity (at least in the form of surveys and investigations) there does not appear to have been any positive action of consequence even in the military field until after the War of 1812. One such indication which also has a certain interest in itself is a report, Armistead to —, 25 December 1807, in which Engineer Capt. W. K. Armistead reported from Fort St. Philip on, among other things, the existence of a ruinous "Ft. Bourbon" across the river — i.e., at or near the site of the future Fort Jackson. Armistead considered the site unsuitable for masonry fortification.

[14] Swift to Dallas, 21 March 1815, Buell 546 NA.

[15] —To Dumas, 4 May 1815, Buell 555 NA orders Dumas to New Orleans. —to Gadsden, 13 January 1816, Buell 631 NA contains Gadsden's orders; Swift to —, 16 October 1815, Buell 685 makes it plain that Dumas has been arrested, though not why; Buell 808 NA is Gadsden's report to Jackson. The title is given Gadsden in the *Monthly Returns of the Corps of Engineers*, Record Group 77 NA, which will hereafter be cited as *Monthly Returns*. The *Returns*, by the way, are available in two record groups, the work copies retained by the Corps (RG 77) and the fair copy submitted to The Adjutant General (RG 94).

[16] Hill, *Roads, Rails and Waterways*, 6-9.

[17] Orders to Gen. Bernard and —, 10 February 1817, Buell 710 NA.

[18] Poussin was sent on a per diem arrangement: "whilst on Topographical Duty, you will be allowed one dollar and an half per day . . ." Swift to Poussin, 10 February 1817, Buell 712 NA. Strictly speaking, all ranks in the Topographical Engineers were brevet ranks until Jackson organized the service as a separate bureau in 1831. In 1817, they were still subordinate to the Chief of Engineers.

[19] Swift to Gadsden, 9 April 1818, Buell 758 NA.

[20] Swift to Cox, 28 July 1818, Buell 806 NA. Evidently the agent handled the money under the "total" supervision of the local Engineer. This arrangement is not easy to understand, except on the supposition that Cox was an employee of the Treasury. Materials and workmanship were supplied by a Washington firm.

[21] The forts built for the "third war" against England were never used against a foreign enemy, but several of them became bloody and famous during the Civil War.

[22] *Laws of the United States Relating to the Improvement of Rivers and Harbors*, 3 vols. (Washington: Government Printing Office, 1940), I, 21. Hereafter cited as *Laws Relating to Rivers and Harbors.*

[23] *Ibid.*, 22.

[24] *House of Representatives Document 35*, 17 Congress 2 Session (1823); Andrew A. Humphreys and Henry L. Abbot, *Report upon the Physics and Hydraulics of the Mississippi River* (Washington: Government Printing Office, 1876), 121.

[25] *Laws Relating to Rivers and Harbors*, I, 27.

[26] *Proceedings of Congress*, 18 Congress 1 Session (1824), 3217.

[27] *House of Representatives Document 2*, 20 Congress 1 Session (1827), 51-52. This report of the Secretary of War, James Barbour, has an excellent summary of the work undertaken in the years of Adams-Clay nationalism.

[28] *House of Representatives Document 125*, 20

Congress 1 Session (1828) is the Bernard-Poussin report. The quoted phrase used in the preceding citation will be found in this report, 41.

[29] However, officers from other branches were regularly detailed to the Engineers and the Topographical Engineers. Andrew A. Humphreys, for example, was detailed from the artillery.

[30] *House of Representatives Document 2*, 21 Congress 2 Session (1820), 12.

[31] *House of Representatives Document 1*, No. 17, 22 Congress 2 Session (1832), *passim.*

[32] Hill, *Roads, Rails and Waterways*, 214.

[33] *Ibid.*, 128.

[34] Shreve to Gratiot, *House of Representatives Document 1*, 23 Congress 1 Session (1834), 126-130.

[35] Elliott, *Improvement of the Mississippi*, I, 69.

[36] Humphreys and Abbot, *Physics and Hydraulics*, 396-403. These two cutoffs are taken as the standard for study. It should be noted that the modern view does not hold that all cutoffs are feasible, but that each one proposed must be studied independently. "The extent and character of the channel changes which follow a cutoff depend entirely upon local conditions. No general rule covering them can be deduced." Elliott, *Improvement of the Mississippi*, I, 61. For an account of Ferguson's work, see his *History of the Improvement of the Lower Mississippi River for Flood Control and Navigation*, 1932-1939 (Vicksburg: Mississippi River Commission, 1940).

[37] Harrison, *Alluvial Empire*, 61-65; Humphreys and Abbot, *Physics and Hydraulics*, 154 *et seq.*

[38] *Ibid*, 67-87; Martha Virginia Shipman, "The Mississippi River Commission," Unpublished M. A. Thesis (University of Arkansas, 1937), 10-11. The flood of 1849 inundated a large part of New Orleans as well as agricultural land. See Harry Kmen, "New Orleans' Forty Days in '49," *The Louisiana Historical Quarterly*, XL (January 1957), 24-45.

[39] *Laws Relating to Rivers and Harbors*, I, 116.

[40] *Returns of the Bureau of Topographical Engineers*, October 1850 and January 1852. In 1851 Humphreys was taken ill in the field. He traveled to Europe, partly for study and partly to regain his health and, following his return, was assigned to office work on the Pacific Railroad projects at Washington. It was probably here that he met Henry L. Abbot, who had done field work on the same surveys. When the Delta Survey was resumed in 1857, Abbot took over the field work, in which he received assistance from the distinguished civilian scientist Caleb G. Forshey. See the introduction to the *Physics and Hydraulics.*

[41] Charles Ellet, *The Mississippi and Ohio Rivers: Containing Plans for the Protection of the Delta* (Philadelphia: Lippincott, Grambo & Co., 1853). Previously printed as *Senate Executive Document 20*, 32 Congress 1 Session (1852) in an edition of three thousand copies, three hundred of which were for the use of the Topographical Bureau. Hereafter cited as Ellet, *Mississippi and Ohio.*

[42] Elliott's volumes, which may be considered an official publication of the Mississippi River Commission, give praise to Ellet's work: "In general, Ellet's studies are worthy of admiration. He not only prophesied the alarming increases in flood elevations which have since occurred, but his flood plan is in many respects remarkably similar to the present adopted project. Ellet's greatest mistake was probably his advocacy of headwater reservoirs. His conclusions here were unsound." This was written after the 1927 flood had demonstrated the inadequacy of "levees only." Elliott, *Improvement of Mississippi River*, II, 302.

[43] Ellet, *Mississippi and Ohio*, 63.

[44] These are essentially the criticisms of Humphreys and Abbot. See *Physics and Hydraulics*, 407-408. A more recent description of the various types of reservoirs and the difficulty of combining different functions — flood control and navigation, for instance, or flood control and power production — in the same reservoir system, may be found in Elliott, *Improvement of Mississippi River*, II, 290.

[45] Elliott says, "[Ellet] apparently regarded levees as a dangerous expedient to be used only when no other method of flood control was practicable." *Improvement of Mississippi River*, II, 308. This seems to me to overstate the case.

[46] *Senate Executive Document 20*, 32 Congress 1 Session (1852), 49-50.

[47] See for example Humphreys and Abbot, *Physics and Hydraulics*, 114-115.

[48] *Ibid.*, 350.

[49] The work was translated into the principal European languages, and was widely and favorably greeted by Continental engineers. Heinrich Grebenau, the Royal Bavarian Officer of Public Works who translated it into German in 1867, hailed it as "an undoubted epoch in the history of hydraulics ." One authority who was not impressed was Dr. G. Hagen, Director General of Public Works in Prussia. Some insight both into the European influence of the work and Humphreys and Abbot's style as scientific controversialists can be gained from their "Reply to

Criticisms Made by Dr. Hagen," *Van Nostrand's Eclectic Engineering Magazine*, XVIII (January, 1878), 1-8.

[50] On "levees-only" see Humphreys and Abbot, *Physics and Hydraulics*, 428-445. The other points will be discussed at length in the following chapters. There is a summary biography of Humphreys in *House of Representatives Committee Print No. 14*, 87 Congress 1 Session (1961), 18, a publication of the Committee on Public Works on the occasion of the centenary of the report.

[51] *House of Representatives Document 185*, 22 Congress 1 Session (1831-1832), 53-54.

[52] *Monthly Returns*, March 1840; September 1840; March 1841; May 1841; September 1842.

[53] *Monthly Returns*, November 1845; November 1846; January 1847; December 1847; August 1848; September 1852; October 1852. The general distribution of rank in August 1848, by the way, also saw Robert E. Lee made a Brevet Colonel, Henry Halleck a Brevet Captain, and George B. McClellan a Brevet Captain.

[54] Hill, *Roads, Rails and Waterways*, 138; *Monthly Returns*, September 1852; October 1852; November 1852; May 1853; September 1853; October 1853. Smith was made Captain in July 1853 and died on 13 September of the same year.

[55] *House of Representatives Report 88*, 34 Congress 1 Session (1856) contains a critical report by the Committee on Commerce on Davis' action, and the text of the proposed contract with Eads & Nelson. McHenry, *Addresses and Papers of James B. Eads*, vii, says that the proposal passed the House of Representatives "but failed for want of time in the Senate."

[56] *Annual Report of the Chief of Engineers for 1866*, in *House of Representatives Executive Document 59*, 39 Congress 1 Session (1866), 9 *et seq.* References to these reports will henceforth be given in the form *Annual Report* (1866). It should be noted that not all forms of civil works were abandoned; efforts to open the Passes of the Mississippi continued intermittently, and the Pacific railroad surveys were carried out by the Topographical Bureau. These were works desired for various reasons by powerful elements of the Democratic Party, especially in the South, and are notable exceptions to the overall trend of events under the so-called "doughface Presidents," Pierce and Buchanan.

[57] *Monthly Returns*, February 1856; October 1856; April 1857; November 1860; January 1861; February 1861. Among others, the following officers were supplied to the contending armies by the Corps of Engineers and the Topographical Engineers: George B. McClellan, Robert E. Lee, Henry W. Halleck, William S. Rosecrans, P. G. T. Beauregard, Kirby Smith, George Gordon Meade, John Pope, and Godfrey Weitzel. (Rosecrans had left the Army in 1847 and did not rejoin until the outbreak of war.)

CHAPTER TWO

[1] In the 15 years between 1861 and 1876, the production of Delta staples dropped from 469,000 hogsheads of sugar and 2.3 million bales of cotton to 135,000 hogsheads and 1 million bales of cotton. The House committee which gives these figures is certainly correct in blaming the failure to recover from the war upon the fact that the "heart of the richest valley in the world . . . is annually inundated by the waters of the Mississippi." *House of Representatives Report 494*, 44 Congress 1 Session (1876), 1.

[2] Between 1860 and 1870 the states drained by the Mississippi increased 64 percent in population. Manufactures in some cases increased five times over. During debate of the Eads bill, "Granges, boards of trade, chambers of commerce, political conventions . . . as well as . . . State legislatures" were cited in Congress as demanding the opening of the Passes. *Congressional Record*, 43 Congress 2 Session (1875), 1442-1443. The boom in the regions that used the Mississippi as a road of commerce does not, of course, contradict the simultaneous picture of desolation in the inundated regions of the Delta. Boom and depression existed simultaneously and both contributed to the shaping of Federal policy for the river.

[3] The accompanying chart is based on C. H. Chorpening, "Waterway Growth in the United States," *Centennial Transactions of the American Society of Civil Engineers* (1953), 1001. The best summary of the post war change in attitude I have found is an address by James B. Eads, the future builder of the jetties, to the Mississippi Improvement Convention, 12 February 1867: "Formerly constitutional objections were urged against the improvement of these rivers by those who had no scruples in voting for seaboard works. But such objectors are now rare, and their mischievous quibbles are generally rejected by a loyal people. . . . Does any statesman gainsay [Washington's] right to do it then? Does any patriot question its power to do it when the Union was in peril? When the necessity occurred there was a power in the government somewhere to provide for it." Estill McHenry (ed.); *Addresses and Papers of James B. Eads, together with a Biographical Sketch*. (St. Louis: Slawson & Co., Printers, 1884), 1. Eads' statement not only sums up the change, but by implication (why was he giving the speech? Why was the convention necessary?) shows that there were still plenty who believed in the "mischievous quibble."

[4] *Monthly Returns*, March 1861.

[5] Later under Maj. Gen. Nathaniel P. Banks.

[6] *Monthly Returns*, March 1862.

[7] *Ibid.*, March 1864.

[8] Capt. and Bvt. Lt. Colonel George L. Gillespie. The Military Division was renamed the Department of the Gulf in August 1866 and later, under the Second Reconstruction Act, became part of the Fifth Military District (Texas and Louisiana). Gillespie stayed until 22 August 1867.

[9] *Monthly Returns*, December 1865; March 1866; August 1866. *Annual Report* (1866), 364.

[10] The evolution of the responsibilities of the New Orleans District will be treated in the topical chapters that follow.

[11] *Annual Report* (1866), 9 *et seq.*

[12] *Annual Report* (1867), 376 *et seq.* Capt. and Bvt. Maj. Charles Howell, later to be District Engineer at New Orleans, was chief assistant to Maj. and Bvt. Col. John N. Macomb, who had charge of the Office of Western River Improvements at Cincinnati.

[13] *Proceedings of the Convention for the Improvement of the Mississippi River* (Washington, D.C.: Mississippi River Improvement Convention, 1884), 31. The language of the speakers at the convention is only a colorful and unrestrained repetition of the viewpoint that Howell stated in his official report a decade earlier. See *Annual Report* (1874), Appendix R, 5-6. For that matter, McAlester had mentioned the same possibility in 1866: see *House of Representatives Document 56*, Part 2, 39 Congress 2 Session (1866), 236-243.

[14] Public Works Act of 23 June 1867.

[15] The Danube also discharges into a sheltered sea. The Sulina outlet of the Danube (where jetties had been successfully employed) was the subject of innumerable studies and polemics by American engineers trying to show that it was, or was not, similar to the Passes of the Mississippi and that the Black Sea was, or was not, a useful analogue to the Gulf of Mexico. See for example the discussion in Barnard's minority report of 29 January 1874, in *Annual Report* (1874), 73-76.

[16] This pass has had a remarkable number of names, the most sensible of which, Northeast Pass, is unfortunately no longer used. Le Page du Pratz, *The History of Louisiana* (New York: Lamport, Blakeman & Law, 1853), 117 calls it East Pass but notes the existence of another small pass nearby called Otter Pass, which is "fit only for pettyaugres." Since *loutre* is French for otter, it seems probable that the name was transferred to the larger pass and then fractured by folk etymology into Pass a l 'Outre ("Pass to the Outside"). The most common form in the 1870's was Pass a Loutre which, if it is neither French nor English, is at least simple and contemporary and is adopted here.

[17] Elliott, *Improvement of the Mississippi River*, I, 6.

[18] Summaries in *Annual Report* (1874), appendix R, 19 *et seq.* See also *Annual Report* (1866), 240.

[19] *Laws Relating to Rivers and Harbors*, I, 152.

[20] *Annual Report* (1866), Appendix XX, 236; *ibid.* (1867), Appendix F, 362.

[21] *Ibid.*, 370-372; *Monthly Returns*, October 1867.

[22] *Ibid.*, July 1868.

[23] *Annual Report* (1869), 260.

[24] From a "memoir" prepared by William M. Burwell and included in Howell's report for 1867. Burwell also estimates the ultimate cost of the *Essayons* at $350,000. *Annual Report* (1874), Appendix R, 19 *et seq.*

[25] *Annual Report* (1874), 260.

[26] Chase's report is dated 9 February 1837. I have not yet been able to obtain a copy. His conclusions however may be deduced from his letter to General Charles Gratiot, Chief of Engineers, in 1836. At the request of the New Orleans Chamber of Commerce, Chase informs Gratiot, he has dispatched a surveying party to the river mouth. He then proceeds to anticipate their conclusions. " . . no improvement by art either by dredging or by permanent jettees or piers can be accomplished so as to secure permanent benefit I would also recommend that the proposition to cut the canal recommended by Major Buisson [?] be at once adopted . . . and that the sum of $500,000 be asked for the commencement of this work. The surveys, plans and details," he adds coolly, "will not furnish data to alter materially this estimate." Letters of Capt. W. H. Chase, No. 147, Record Group 77, National Archives. A. "M. Buisson" is spoken of by Ellet as "a distinguished engineer of New Orleans," in *Senate Executive Document 20*, 32 Congress 1 Session (1852), 20.

[27] *Laws Relating to Rivers and Harbors*, 119.

[28] *House of Representatives Executive Document 16*, 33 Congress 1 Session (1852).

[29] *Annual Report* (1875), Appendix R, 5-15 and 50-52.

[30] *Monthly Returns*, July 1866.

[31] *Annual Reports* (1874), Appendix R, 79.

[32] By this time the rise of the Granger movement was exerting pressure on Congress to find farm products an alternative route to market. See e.g. the statement of Congress Williams of Wisconsin: "However flippant the term may be on the tongue here [at Washington], whether you denominate it the 'grangers', the 'hay-seed', or the plain 'farmers' movement', or whatever glee all this cheap wit may create, still the sober question remains to the people of the West, 'How shall the cheap transportation of our surplus products from the interior to the seaboard be best secured?' " *Congressional Record*, 43 Congress 2 Session (1875), 1442. Williams was speaking in favor of the first (House) version of the Eads bill.

[33] He built the propeller-driven ironclads *Milwaukee* and *Winnebago* among others. *Congressional Record*, 43 Congress 2 Session (1875), 1505. Eads' ironclads are said to have seen action more than a month before the fight of the *Monitor* and *Merrimac*. McHenry, *Addresses and Papers of James B. Eads*, vii-viii. Eads is a figure who naturally provokes partisanship, and his biography by Florence Dorsey, *Road to the Sea* (New York and Toronto: Reinhart, 1947) is recommended with reservations. Nevertheless it contains some revealing incidents. Eads' career involved a good deal of spectacular immodesty as well as genius and an amazing amount of sheer hard work. At the Fourth of July celebration honoring his St. Louis bridge, a triumphal arch was erected and topped by a self-portrait "tastefully decorated with evergreens and fifty feet high." *St. Louis Missouri Republican*, 5 July 1874, quoted in *ibid.*, 161. Both Eads and Humphreys were great engineers, both egoists possessing adamantine certainties about their own abilities. But Eads was the maverick entrepreneur, Humphreys the type of strong-man who identifies with an organization. Each considered himself the supreme authority on the Mississippi River. The clash between them was predestined, if anything ever was.

[34] Elmer Lawrence Corthell, *A History of the Jetties at the Mouth of the Mississippi River* (New York: John Wiley and Sons, 1881), 365. Hereafter cited as Corthell, *History of the Jetties.*

[35] *House of Representatives Executive Document* 114 (Part 2), 43 Congress 2 Session (1875).

[36] *Congressional Record*, 43 Congress 2 Session (1875), 1441. This was by no means the first suggestion for involving private enterprise in the work on the river. Previous proposals had usually been for a "Mississippi Levee and Telegraph Company," or some variant thereof. The idea was to have levees constructed by a private company under specifications set by a mixed board of civil and military engineers. See *Senate Miscellaneous Document 3*, 42 Congress Special Session (1871), 1-4; *House of Representatives Report 44*, 42 Congress 2 Session (1872), 16; *House of Representatives Executive Document 187*, 42 Congress 3 Session (1873), 1-7.

[37] In 1851 Ellet had reported that "at the head of South Pass . . it is now scarcely possible for any useful craft to enter. A spit of sand has formed directly in the mouth of the pass, which has almost entirely closed up the entrance, and destroyed it for all commercial purposes." *Senate Executive Document 17*, 31 Congress 2 Session (1851), 3-4. The Engineer board of Chase, Latimer, Bernard, and Beauregard called the pass "now quite insignificant." *House of Representatives Executive Document 16*, 33 Congress 1 Session (1854), 4-5.

[38] The chief provisions of the Act of 3 March 1875 were as follows:

Depth	Width	Payment
20 Ft	200 Ft	$ 500,000
22 "	200 "	500,000
24 "	250 "	500,000
24 "*	250 "	250,000
26 "	300 "	500,000
26 "*	300 "	250,000
28 "	350 "	500,000
28 "*	350 "	250,000
30 "	350 "	500,000
30 "*	350 "	500,000
		$4,250,000

*Indicates money payable when the channel had been maintained for 12 consecutive months. Five percent interest was added, to date from the first attainment of the specified depth and width.

The remaining $1 million was retained, 5 percent interest being paid to Eads and associates, and the principal becoming payable in two equal installments, at the end of 10 and 20 years, provided the 30- by 350-foot channel was maintained. In addition, $100,000 per year for maintenance was to be paid from the first attainment of the 30- by 350-foot channel, which Eads was to maintain for 20 years. Thus, payment would total $8 million.

From *Laws Relating to Rivers and Harbors*, I, 246-247.

[39] *Monthly Returns*, June 1875.

[40] *Ibid.*, February 1877. M. R. Brown, "Annual Report upon the Improvement of South Pass of the Mississippi River Showing the Condition of the Works on June 30, 1878," 24. In *Annual Reports, New Orleans, La., Engineer District, II.*

[41] Corthell, *History of the Jetties*, 344-345; *Annual Report* (1875), Appendix S; *House of Representatives Executive Document 12*, 44 Congress 2 Session (1876); diagrams and charts accompanying *Annual Report* (1880), Appendix L.

[42] Cf. Discussion of the *Grand Republic* incident in Corthell, *History of the Jetties*, Appendix VIII, 278-295. Eads charged that a boatload of visiting capitalists were intercepted by one of Howell's assistants who gave them information designed to show that the Gulf was shoaling beyond the jetties.

[43] By the terms of the final bill the 30-foot channel was still required, but no width was specified. If a continuous line of 30-foot depts wide enough to receive the sounding lead could be found, Congress would be satisfied. *Laws Relating to Rivers and Harbors*, I, 281-283; 301-302.

[44] Note especially the boards of 1874 and 1878, which reported favorably on the jetty system both before and after Eads had done his work, and the reports of Micah Brown. See *Annual Report* (1875), Appendix S, 6 *et seq.*; citation note 43.

[45] Corthell, *History of the Jetties*, 26-27 reports a critical speech by Carl Schurz, for example. Humphreys and Eads, by the way, had had a previous collision over the St. Louis bridge. See Dorsey, *Road to the Sea*, 147-152.

[46] *"The conclusion is inevitable: the jetties must be extended annually at the same rate that the bar is advancing, if we intend to maintain permanently the same depth upon the bar.* If the depth to be maintained is 27 feet at low water, or 28 feet at high water, it will be found that the annual advance will not be less than 1,200 feet." Humphreys and Abbot, *Physics and Hydraulics*, 672. Italics in original. This analysis, published as an appendix to the *Physics and Hydraulics*, was originally prepared by Humphreys as part of his campaign against the jetties. It appears also in the *Annual Report* (1874), Part 1, 854-867, and in *House of Representatives Executive Document 220*, 43 Congress 1 Session, 1-15.

[47] Howell's results were probably attributable to negligence. The contours of the Gulf bottom beyond the jetties were continually changing during the course of the work, and a few scattered soundings might give almost any results.

[48] See Eads' complaints in Corthell, *History of the Jetties*, 279-295.

[49] *Ibid.*, 305-308.

[50] New Orleans *Democrat*, 6 May 1876.

[51] Corthell, *History of the Jetties*, 305.

[52] M. R. Brown, "Annual Report," 24-27. In *Annual Reports, New Orleans, La., Engineer District, II.* Also *Senate Executive Document 95*, 45 Congress 2 Session (1878), 46-47.

[53] The first seagoing vessel to enter the river by the jettied pass was the *Hudson* on 12 May 1876. During 1877, 587 ocean vessels went through the pass, and by 1879 Southwest Pass was almost abandoned except by fishing boats and schooners. Dorsey, *Road to the Sea*, 206, 213. The same year a New York paper reported, "To realize how much the jetties have already done for New Orleans, one has only to sail along the riverfront of the city, where I counted last week no fewer than one hundred and twenty large square-rigged sailing vessels and eighteen ocean steamers. Fully four-fifth of these ships come from foreign ports." New York *Daily Tribune*, 29 March 1879.

[54] Corthell, *History of the Jetties*, 320-330.

[55] *Senate Executive Document 8*, 40 Congress 1 Session (1866), 13.

[56] *Annual Report* (1869), 327 *et seq.* A bill was considered by the Senate Committee on Commerce to underwrite State bonds of Louisiana, Mississippi, and Arkansas for levee repairs but apparently the scheme came to nothing. *Senate Miscellaneous Document 8*, 41 Congress 1 Session (1869), *passim.* Louisiana was reported to have issued $8 million in bonds for levees by 1872 without any appreciable success in defending her best cotton land. *House of Representatives Report 44*, 42 Congress 2 Session (1872), 6.

[57] Elliott, *Improvement of the Mississippi*, II, 162; *Annual Report* (1875), 539. The commission was composed of Bvt. Maj. Gen. G. K. Warren, Bvt. Brig. Gen. Henry L. Abbot, Bvt. Maj. W. H. H. Benyaurd, Jackson E. Sickels, and P. O. Hebert, The three-and-two makeup, with the president chosen from the Corps personnel, has the same form as the House plan for the Mississippi River Commission.

[58] *Ibid.*, 552; 539 *passim*; Elliott, *Improvement of the Mississippi*, II, 162.

[59] *Annual Report* (1875), 564-565.

[60] The flood of 1874 opened this decade of transformation, as the flood of 1882 brought it to its climax. In 1874 Congress authorized the President to issue food and rations to the sufferers and followed up by creating the Levee Commission. There is some interesting background on the state of Congressional feeling at this time in Martha Virginia Shipman, "The Mississippi River Commission," Unpublished Master's Thesis (University of Arkansas, 1937), 14-15.

[61] Conventions were held at St. Louis in 1877 and

1881 and at Washington in 1884. See *Give Us an Unobstructed Mississippi* (St. Louis: J. J. Daly and Co., printers, 1877); *Official Report of the Proceedings of the Mississippi River Improvement Convention* (St. Louis: Great Western Printing Co., 1881); and *Proceedings of the Mississippi River Improvement Convention* (Washington: n.p., 1884).

[62] *Tom Sawyer* appeared in 1875, *Life on the Mississippi* in 1883, and *Huckleberry Finn* in 1884.

[63] *Congressional Record*, 46 Congress 2 Session (1879), 1730.

[64] *Ibid.*, 2101.

[65] See Senator Ferry's speech in favor of the defeated amendment. *Congressional Record*, 46 Congress 1 Session (1879), 2102.

[66] The act creating the commission is in *Laws Relating to Rivers and Harbors*, I, 304. The critical paragraph is Section 4: "It shall be the duty of the said commission to take into consideration and mature such plan or plans and estimates as will correct, permanently locate, and deepen the channel and protect the banks of the Mississippi River; improve and give safety and ease to the navigation thereof; prevent destructive floods; promote and facilitate commerce, trade, and the postal service . . *Provided*, That the commission shall report in full upon the practicability, feasibility, and probable cost of the various plans known as the jetty system, the levee system, and the outlet system, as well as upon such others as they deem necessary."

The effect of this Delphic utterance was to establish channel stabilization as the primary, but rather vague and indefinite goal, and to open the way to the advocates of levee building, who began by urging it as a means of stream stabilization and channel improvement and ended by frankly building for flood control.

[67] Shipman, "Mississippi River Commission," 26-33, reports many quotes from the debates which would tend to support this conclusion. See also Robert Harrison, *Alluvial Empire*, 150-152.

CHAPTER THREE

[1] A notable exception was Brig. Gen. Cyrus Comstock, a strict constructionist who found himself on the short end of many a 6-1 vote.

[2] *House of Representatives Executive Document 58*, 46 Congress 2 Session, 22-23.

[3] This board was abolished and its duties transferred to the Commission by Special Order 83, Headquarters of the Chief of Engineers, 25 July 1879. *Monthly Returns*, July 1879.

[4] Longitudinal dikes were constructed of pilings and willow mattresses, with transverse dams to connect the upper ends to the banks, which were revetted for protection against eddies. See Shipman, "Mississippi River Commission," 35; Elliott, *Improvement of the Mississippi*, III, Plates LIX and LX.

[5] *Proceedings of the Mississippi River Commission*, I (1879-1884), 21 January 1880, 14; 7 May 1881, 2. Hereafter cited as *Commission Proceedings.*

[6] The Commission resolved in 1880 that a levee system "gives aid to navigation, promotes and facilitates commerce trade and the postal service," a repetition of the language of the organic law. *Commission Proceedings*, I, 22 January 1880, 20. However, it held also that levees were works subsidiary to the main purpose of channel stabilization. *Ibid.*, 25 March 1881, 7-9. The remark about experimental work is in *ibid.*, 24 March 1881, 6.

[7] *Annual Report* (1883), Pt. 1, 2118.

[8] *Laws Relating to Rivers and Harbors*, I, 382.

[9] *Annual Report* (1882), Pt. 2, 1354.

[10] On the extent of the flood, see illustration. "During this flood an area of 34,600 square miles in the lower valley was overflowed to an estimated average depth of six and one-half feet. The river was above bank-full stage for sixty days at Cairo and eighty days at Red River Landing, La." Elliott, *Improvement of the Mississippi*, I, 97. Plea of Greenville, *Commission Proceedings*, I, 16 August 1882, 6. Plea of 11 Louisiana Parishes, *ibid.*, 19 November 1882, 4. Statement of Sen. Lamar, *ibid.*, 15 August 1882, 3.

[11] *Ibid.*, 16 August 1882, 6.

[12] *Ibid.*, 17 August 1882, 10. Gen. Quincy A. Gillmore, the president, did not vote. Eads and Judge R. S. Taylor were absent, Eads being in poor health at the time. In a letter to the Commission (*ibid.*, 15) he asked that this vote be recorded in the affirmative on any proposition to close the levee gaps.

[13] On levee priorities, see *Commission Proceedings*, III, 4 August 1892, 38. On the standard gage see e.g. *ibid.*, 11 November 1899, 614. An example of maintenance rulings (forbidding cuts, pipes and flumes) is given in *ibid.*, 24 March 1891, 10. Commission standards were of course extended as its authority grew to cover virtually the whole river above the Head of Passes, and the major tributaries as well. See summary in *Annual Report* (1928), 1876-1877.

[14] *Commission Proceedings*, 27 November 1886, 13-15; *ibid.*, 10 May 1884; 8; *ibid.*, 12 November 1900, 686; *Annual Report* (1821), 1958.

[15] *Commission Proceedings*, 9 July 1897, 455.

[16] *Commission Proceedings*, 22 July 1897, 438-440.

[17] George D. Waddill, "Memorandum for Mr. Chas. Senour: Subject: Flood Fighting, New Orleans District, 1898 to 1927," 7 May 1947, Par. 17. George D. Waddill Papers, NOD Library. Hereafter cited as GDW Papers. Interview with Jake Muether, Pass Christian, Miss.

[18] "When the Mississippi River Commission was created, the report of Humphreys and Abbot became a virtual 'Bible', and successive generations of engineers saw fit to repeat the conclusions of the report. The idea that levees afforded the only sensible means of control became fixed in the minds of official engineers." Harrison, *Alluvial Empire*, 122-123. The viewpoint advanced in the text is not meant to deny this influence, but to point out that the idea could become fixed because, until 1927, there were not enough political and practical pressures at work to "un-fix" it. Where such pressures existed, the opinions set forth in the "Bible" were abandoned with great readiness, as the text will show.

[19] "It would seem, therefore, that a closure of the crevasses might be expected to accelerate the removal of those shoals which have been produced by them..." reported the Commission on 17 February 1880. Compare Humphreys and Abbot, *Physics and Hydraulics*, 412: "Direct measurements do not show that deposits occur in the river channel below the crevasses."

[20] Report by Dr. George Little in *Annual Report of the Mississippi River Commission* (1882). Hereafter cited as *Annual Report of the Commission*. The theory that an almost impervious "blue clay" forms the bed of the river was introduced in the *Physics and Hydraulics*, 91-95, was repeated by Humphreys throughout his life, and became part of the accepted lore of the river. This represented a serious underestimate of the depth of Quaternary sediments in the Delta. As Elliott has noted, "This theory had, of course, an important bearing on the character of engineering operations applicable to river improvement." Elliott, *Improvement of the Mississippi*, I, 33.

[21] *Commission Proceedings*, II, 1 July 1887, 9; *ibid.*, 30 June 1887, 2.

[22] *Commission Proceedings*, 2 October 1890, 10. "The work to be done, which is necessary to protect the [Atchafalaya] district from another inundation, should the water of 91 reach the line of the last flood, will cost in money far more, than we have or can expect to raise this year. In spite of popular clamor, we have levied the extreme limit of taxation which is claimed to be so onerous that mass meetings of the people are being called to protest against collection. It is true that the power to issue bonds has also been conferred upon [us], but owing to stringency here and in New York of the money market, we have failed to negotiate them." See 12-23 *passim*. The plea of navigation is sometimes still made, but is more often omitted, as in the plea quoted.

[23] *Laws Relating to Rivers and Harbors*, I, 577-578. A resolution appropriating $4 million to meet the spring flood of 1891 restored the clause forbidding levee construction for flood control, apparently in a purely formal and pietistic spirit, since the Commission had long grown adept in justifying any levee by the navigation criterion. The revival of the clause is variously explained, but the reasons seem to come down to this: levee opponents wanted the restriction, and proponents felt it did not matter.

[24] *Laws Relating to Rivers and Harbors*, I, 609; *Commission Proceedings*, 19 Marcy 1891, 2-3. The revival brought forth some blunt talk from riparian politicians and local interests: the levee boards were burdened with debt; the restriction was not meant, and should not be taken, seriously. See *Commission Proceedings*, 15 July 1891, 11-19. The votes which followed indicated that the Commission agreed. *Ibid.*, 19-20. The proviso disappeared again in subsequent acts and was not revived.

[25] *Ibid.*, 1 October 1890, 1-9, 16.

[26] *Ibid.*, 29 November 1890, 19.

[27] *Ibid.*, 2 August 1892, 62-63.

[28] *Ibid.*, 11 January 1896, 296-297; *Laws Relating to Rivers and Harbors*, I, 785.

[29] *Index to Annual Reports* (1866-1912) I, 1085.

[30] C. H. Chorpening, "Waterway Growth in the United States," *Centennial Transactions of the Aemrican Society of Civil Engineers*, CT (1953), 1024.

[31] Threat to sue, *Commission Proceedings*, 27 June 1894, 166; Weather Bureau bulletin quoted, Harrison, *Alluvial Empire*, 120.

[32] *Ibid.*, 123.

[33] *Ibid.*, 124.

[34] *Ibid.*, 159.

[35] John C. H. Lee, "A Flood Year on the Mid-Mississippi," *The Military Engineer* (July-August 1928), 306. This and other gage readings, by the way, indicate height above a standard low point. The zero, though supposed to represent extreme low water, is in fact a standardized benchmark, and minus readings

are occasionally reported. See Elliott, *Improvement of the Mississippi*, I, 76.

[36] *Ibid.*, 307. See also *House of Representatives Document 798*, 71 Congress 3 Session (1931), 99.

[37] New York *Times*, 17 April 1927, 9.

[38] See Elliott, *Improvement of the Mississippi*, III, Plate XXVII, for a vivid picture of the rainfall distribution. Many areas contiguous to the river received from one third to one half their normal annual precipitation during these 2 months alone. Compare *ibid.*, Plate II. The heavy rains of the preceding fall and winter saturated the terrain and filled the natural reservoirs. Rainfall was worst in Arkansas, Missouri, Tennessee, and Louisiana, and the rains of December, January, and March were responsible for the three great "waves" of the flood, each following a month after the precipitation. See *House of Representatives Document 798*, 71 Congress 3 Session (1931), for a comprehensive statistical and descriptive summary of the flood, 96 *et seq.*

[39] This was the "Good Friday rain" which some older residents of the city still remember.

[40] New York *Times*, 19 April 1927, 1.

[41] *Ibid.*, 2.

[42] *Ibid.*, 20 April 1927, 7.

[43] The crevasses of 1927 had a combined length of 5.2 miles, and water escaping through them overflowed about 23,000 square miles of land. Elliott, *Improvement of the Mississippi*, I, 114.

[44] New York *Times*, 24 April 1927, 1.

[45] Lee, "A Flood Year on the Mississippi," 309.

[46] New York *Times*, 22 April 1927, 1.

[47] *Ibid.*, 23 April 1927, 1.

[48] *Ibid.*, 24 April 1927, 1.

[49] *Ibid.*, 27 April 1927, 1.

[50] *Ibid.*, 30 April 1927, 1, 29.

[51] Estimates by the Secretary of War. *House of Representatives Document 90*, 70 Congress 1 Session (1927), 2. The Mississippi Flood Control Association estimate of direct damages was $236,334,414.06. *Ibid.*, 10.

CHAPTER FOUR

[1] See for example Gifford Pinchot's testimony in *Hearings before the Committee on Flood Control of the House of Representatives* (Washington: Government Printing Office, 1927), V, 3469-3472. These hearings were marked by extreme hostility to the Corps on the part of the chairman, Frank R. Reid of Illinois, and others. Reference cited hereafter as *House of Representatives Flood Control Hearings* (1927-1928).

[2] The Jadwin Plan is given in *House Document 90*, 70 Congress 1 Session (1927). The Commission plan was withheld from Congress by Jadwin, but was secured by the committee and printed as *House of Representatives Committee Document 1*, Committee on Flood Control, 70 Congress 1 Session (1927). See also Elliott, *Improvement of the Mississippi*, II, 323. Jadwin's own version of the differences between the plans is given in *House of Representatives Flood Control Hearings* (1927-1928), V, 3581. The four boards reporting to the Chief of Engineers were the Spillway, Diversion, Reservoir, and Navigation Boards. Jadwin considered the Mississippi River Commission a fifth "board," on a level with the others.

[3] *Laws Relating to Rivers and Harbors*, III, 204 *et seq*. The act repeats the language of the Jadwin Plan to a remarkable extent.

[4] *House of Representatives Document 90*, 70 Congress 1 Session (1927), 4-5 and 24.

[5] *House of Representatives Document 798*, 71 Congress 3 Session (1931), I, 5.

[6] *House of Representatives Document 90*, 70 Congress 1 Session (1927), 6-7.

[7] The Jadwin Plan envisioned a total cost of $296.4 million, later raised by Congress to $325 million.

[8] Elliott, *Improvement of the Mississippi*, II, 291-292. Local interests were not always happy about the fuse-plug concept, or, for that matter, about the Jadwin Plan. See *House of Representatives Flood Control Hearings* (1927-1928), V, 4768-4769, and *infra*.

[9] "The chief contentions against the Army Plan are that there is no necessity for floodways and backwater areas of such width and length as the Army Plan provides, and that it lacks provision for indemnification for property to be used, damaged, or destroyed in the areas to be taken over for floodways, backwater areas, and outlets." *Flood Control in the Lower Mississippi Valley, Report Submitted by the Board of State Engineers to his Excellency, Huey P. Long, Governor of the State of Louisiana, November 30, 1929.* (n.p., n.d.), 5. The claim for indemnification was based on the fact that the people of the floodway had previously taken equal chances with the rest of the flood plain — i.e., the levees might crevasse anywhere. By raising the mainline levees and leaving the levees guarding the floodway entrances as

they were (thereby converting them into "fuse-plugs") the flood control plan insured that great floods would enter the floodway areas and no place else. See *ibid.*, 8-9 and *passim*. The Louisiana Board of State Engineers demanded indemnification for flowage rights, restriction of floodway use to only one of the proposed basins, continuous and adequate guide levees, and relocation of traffic arteries which traversed the floodway. *Ibid.*, 22-23. These, plus the demand for control structures in place of the fuse plugs, and the "widening of Berwick Bay sufficiently to discharge the additional floodwaters," were all substantially met by the future evolution of the flood program.

[10] *House of Representatives Document 90*, 70 Congress 1 Session (1927), 3. This was vigorously opposed by local interests which secured total assumption of the burden by the Federal Government. See *Laws Relating to Rivers and Harbors*, III, 2005. This was probably unavoidable because of the nature of the works contemplated. Would Missouri, for example, have consented to appropriate money for flowage rights in the Birds Point-New Madrid Floodway in order to protect Cairo, Illinois, at the expense of its own people?

However, the same paragraph of the Flood Control Act that provided for total Federal assumption of cost also declared for the principle of local contribution, which has, in fact, been resumed as the usual rule. See reference, note 22, this chapter.

[11] Col. Charles Potter, the President of the Commission, was promoted and then ousted and replaced by Brig. Gen. T. H. Jackson, a move widely believed to have been engineered by Jadwin with the support of the White House to insure acceptance of the Jadwin Plan and to bring the Commission to heel. See *House of Representatives Document 90*, 70 Congress 1 Session (1927), 33; references noted in note 2 of this chapter; biography of Potter in Scheufele, *North Pacific Division*, Appendix I.

[12] See Harrison, *Alluvial Empire*, 115-135 for a good brief account of floods from 1897 to 1927.

[13] *Ibid.*, 113 (chart).

[14] *Ibid.*, 122.

[15] See Elliott, *Improvement of the Mississippi*, II, 315 and 319, par. 3 on extension of Commission authority.

[16] Shipman, "Mississippi River Commission," 90-101 gives a much less favorable view of the Commission's role, which of course is easy if one compares it only with what came after and not with what came before.

[17] *House of Representatives Flood Control Hearings* (1927-1928), 3469 *et seq.*; Harrison, *Alluvial Empire*, 123-124.

[18] *Laws Relating to Rivers and Harbors*, III, 1703.

[19] The establishment of the Federal Barge Line played a large part in this revival. See *Mississippi River Navigation* (Vicksburg: Mississippi River Commission, 1970), 5. For present traffic see chart, *ibid.*, Appendix I. Chorpening, "Waterway Growth in the United States," 1025-1026 rightly sees the underlying causes of the revival in the needs of industry and a growing population. The war enormously speeded a redevelopment of water commerce that would have occurred anyway.

[20] *Laws Relating to Rivers and Harbors*, III, 1903, Sec. 3.

[21] *Ibid.*, III, 2404, Sec. 1. This important act also redefined into its present form the responsibilities of local authority in works undertaken by the Federal Government. See *ibid.*, 2405, Sec. 3.

[22] For a discussion of these points see Chapter Six.

[23] War Department General Order 15, Office of the Chief of Engineers, 7 October 1929, Par. 2 and Par. 3.

[24] The reader interested in the cutoff program is referred to Brig. Gen. Harley B. Ferguson, *History of the Improvement of the Lower Mississippi River for Flood Control and Navigation, 1932-1939*. Pages 4 and 5 give a concise account of the Beouf and Eudora Floodways.

[25] *Laws Relating to Rivers and Harbors*, III, 1932.

[26] The report of the Spillway Board is printed as *House of Representatives Document 95*, 70 Congress 1 Session (1927).

[27] Bonnet Carré is shown as a church on the west bank, within the convex curve of the river, on the Bernard and Poussin map. The area identified with the name in recent years is the east bank, i.e. the concave arc of the bend where bank caving normally takes place. Here the river approaches to within 8 miles of Lake Pontchartrain. Pontchartrain in turn connects with the Gulf through Lake Borgne and the Mississippi Sound.

[28] Other crevasses occurred in 1948 and 1959. Elliott, *Improvement of the Mississippi*, II, 198.

[29] Humphreys and Abbot, *Physics and Hydraulics*, 422 *et seq.*

[30] *House of Representatives Document 798*, 71 Congress 3 Session (1931) is the prime source for the first years of the flood control program.

[31] *Ibid.*, 206.

[32] *Ibid.*, 207. Many photographs and plans of the work will be found following *ibid.*, 238.

[33] *Ibid.*, 206.

[34] *Ibid.*, 214 *et seq.*

[35] *Ibid.*, 207-214; 235.

[36] *Ibid.*, Plate III; *Annual Report* (1937), I, 1675.

[37] *Annual Report* (1937), I, 1678.

[38] By comparison, the project flood was visualized as consisting of 2.2 million second-feet from the Ohio and 250,000 from the upper river; or by a different rainfall distribution, 1.45 million from the Ohio and 1 million from the upper river. The 1937 flood was, therefore, about 82 percent of the project flood at Cairo.

[39] *Annual Report* (1937), I, 1679; *Commission Proceedings* (1932-1939), II, 5228-5235.

[40] *Annual Report* (1937), I, 1743; 1679.

[41] *Ibid.*, 1744.

[42] *Ibid.*, 1678.

[43] Harold N. Fisk, *Geological Investigation of the Atchafalaya Basin and the Problem of Mississippi River Diversion* (Vicksburg: Waterways Experiment Station, 1952), I, 8-9.

[44] *Ibid.*, 17-18; 65-68.

[45] William Sommer, "Atchafalaya Basin Levee Construction," Unpublished Master's Thesis (Tulane University, 1966), 8-9.

[46] *Commission Report* (1881), 131.

[47] Quoted in *Commission Report* (1881), 130.

[48] See Chapter One.

[49] Fisk, *Geological Investigation of the Atchafalaya*, 122.

[50] *Annual Report* (1881), Part II, 1391-1392. Benyaurd's report is in *Annual Report* (1880), Part II, 1295.

[51] The Atchafalaya is leveed for 52 miles south of Old River junction. Fisk, *Geological Investigation of the Atchafalaya*, 9. The western rim of the basin (the Teche ridge) and the eastern rim (the Lafourche-Mississippi ridge) were to be leveed and closed by fuse-plugs at the northern ends. Thus three channels were to be created: the Atchafalaya itself, and the West and East Atchafalaya Floodways, the last two to be used during great floods only. Despite the significant changes introduced by the building of the Morganza Floodway and Control Structure in place of the East Floodway, this pattern remains the basic form of the Atchafalaya diversion system.

The floodways converge below the leveed portion of the river, where the whole basin becomes a single gigantic flood channel.

[52] Fisk, *Geological Investigation of the Atchafalaya*, 141.

[53] Rodney A. Latimer and Charles W. Schweizer, *The Atchafalaya River Study* (Vicksburg: Mississippi River Commission, 1951), 35. In 1970 some eastward flow was again observed, for the first time in 28 years. Interview with Jefferson L. Smith, Chief of Construction Division, New Orleans District.

[54] *Ibid.*, 43; 47. Ironically, the Chief of Engineers and the Mississippi River Commission reported favorably on a scheme to enlarge Old River for navigation the same year. See *Senate Document 53*, 82 Congress 1 Session (1951).

[55] Fisk, *Geological Investigation of the Atchafalaya*, 141. A critical period occurs in the deterioration of a channel, when the water velocity drops too low to carry sand. The rapid precipitation which follows blocks the channel with a "sand plug" after which filling is rapid and well-nigh irreversible.

[56] See the excellent series of articles by B. L. Krebs in New Orleans *Times-Picayune*, 20-23 September 1953.

[57] Sommer, "Atchafalaya Basin Construction," *passim*. Sommer is Assistant Chief of the Design Branch in the New Orleans District.

[58] Col. Herbert R. Haar, Jr., "The Atchafalaya Basin," *Acadiana Profile;* to be published. Col. Haar is District Engineer of the New Orleans District. Interview with Herbert Juneau, Lafayette, La., 1971.

[59] Interview with Warren B. Dodd, New Orleans, La., 1971, and Herbert Juneau, Lafayette, La., 1971.

[60] Interview with George H. Hudson, New Orleans, La., 1971.

[61] The concept of comprehensive basin study will be discussed in Chapter Six.

CHAPTER FIVE

[1] The district apparently did not have firm boundaries, but was assigned projects in a region that generally included the Sabine basin but excluded the Mississippi and Red. See for example *Annual Report*

(1902), 329 *et seq.*

[2] Scheufele, *North Pacific Division*, 1.

[3] Creation of divisions, *Annual Report* (1889), 16; assignment of New Orleans to Southwest Division, *ibid.*, 194.

[4] Creation of Gulf Division, *Annual Report* (1902), 62; assignment of Adams, above and *ibid.*, 310.

[5] *Ibid.*, 315-316.

[6] *Senate Document 1*, 19 Congress 2 Session (1826), 217; *House of Representatives Document 185*, 22 Congress 1 Session (1831-1832), 53-54. See also *Annual Report* (1876), 514.

[7] *Treasury Document 373* (1882), cited in *Index to the Annual Reports* (1866-1912), I, 623.

[8] *Annual Report* (1876), 511-514, 523.

[9] *Ibid.*, 508-511.

[10] *Index to the Annual Reports* (1866-1912) 623-624.

[11] *Laws Relating to Rivers and Harbors*, I, 219.

[12] *Annual Report* (1873), 66.

[13] This officer is an intriguing figure in many ways. His life was short (he died in 1882, when he was only 40) and his projects by and large were unsuccessful. Yet, he was responsible not only for the plan of the canal to the Gulf, but also of an imaginative new approach (involving jetties, ironically) for improving the port of Galveston; he directed the first surveys of the Gulf Intracoastal Waterway, and he experimented with mattress revetment for the harbor of New Orleans. See this study, *infra*, for an estimate of his importance to the region.

[14] *Annual Report* (1875), 875.

[15] *Ibid.*, 876.

[16] *Ibid.*, 877-80. This whole section, 876-900, is the first comprehensive study for the route of the western Intracoastal Waterway.

[17] *Laws Relating to Rivers and Harbors*, II, 1127.

[18] *House of Representatives Document 640*, 59 Congress 2 Session (1907), 7.

[19] *Ibid.*, 2, 9; "United States Inland Waterways: Existing and Proposed Routes. Compiled from maps accompanying report of Board of Eng'rs. dated Feb. 1, 1910 and other sources." New Orleans District Library. The Engineer Board which reported on the Florida-Rio Grande section of the national Intracoastal Waterway recommended following one of these canals on grounds of cost. *House of Representatives Document 610*, 63 Congress 2 Session (1914), 40.

[20] George D. Waddill, then a junior engineer with the New Orleans District, has left a description of his part in these surveys. "Memorandum from Mr. Chas. Senour. Subject: Survey of Gulf Intracoastal Waterway — 1907," George D. Waddill Papers, New Orleans District Library.

[21] *House of Representatives Document 610*, 63 Congress 2 Session (1914), 32; *Laws Relating to Rivers and Harbors*, II, 1242.

[22] *Annual Report* (1912), Pt. 1, 659; *ibid.*, (1909), 1468.

[23] *Annual Report* (1917), Pt. II, 2551.

[24] *Laws Relating to Rivers and Harbors*, II, 1352 *et seq.*

[25] This concept was well expressed by Edgar Jadwin, the future Chief of Engineers, when he wrote: "The Mississippi River seems to be started on its proper function, as far as transportation is concerned, of carrying heavy articles to relieve the railroads, and doing it more economically." He viewed the western Intracoastal Waterway as a logical way to develop this function, and he felt that the region west of the Mississippi, with its longer distances and higher freight rates, would especially benefit from the development of waterways for bulk transport. See *House of Representatives Document 640*, 59 Congress 2 Session (1907), 26-27 and *passim*.

[26] *Laws Relating to Rivers and Harbors*, III, 1869.

[27] *Ibid.*, III, 1879.

[28] *House of Representatives Document 238*, 68 Congress 1 Session (1924), 6-7.

[29] Article "Houston," *Encyclopedia Brittanica* (Chicago: The Encyclopedia Brittanica, Inc., 1939), XI, 844-845; *House of Representatives Document 582*, 87 Congress 2 Session (1962), 3.

[30] *House of Representatives Document 238*, 68 Congress 1 Session (1924), 7-8 and accompanying maps and charts.

[31] *Ibid.*, 11.

[32] *Mississippi River Navigation*, 19.

[33] *Laws Relating to Rivers and Harbors*, III, 1899.

[34] *Annual Report of the New Orleans District* (1926), 871.

[35] *Annual Report of the Chief of Engineers* (1930), 5.

[36] *Ibid.*, (1931), 5.

[37] *Ibid.*, (1968), 409-412.

[38] *Mississippi River Navigation*, Appendix A.

[39] See Chapter Two.

[40] Biographical information obtained from Historical Division, Office of the Chief of Engineers, P. O. Box 1715, Baltimore, Md. 21203.

[41] *Annual Report* (1878), Pt. I, 614-617.

[42] *Laws Relating to Rivers and Harbors*, I, 271.

[43] *Annual Report* (1879), 875-878.

[44] *Commission Proceedings*, 18 September 1882, 19.

[45] *Commission Proceedings*, 8 November 1893, 150; 22 July 1897, 442. The Orleans Levee Board applied for Commission funds but was evidently refused.

[46] *Commission Proceedings*, 30 November 1897, 498; 11 December 1898, 515. See also *Maps of the Mississippi River* (Vicksburg: Mississippi River Commission, 1936), Map 46.

[47] Cf. *Commission Proceedings* 20 September 1886, 18; 21 September 1888, 13; 24 September 1888, 24; December 1888, 13; 28 December 1888, 5; 1 July 1896, 360.

[48] See Chapter III; *Commission Proceedings*, 16 March 1897, 419-420.

[49] See *Senate Document 36*, 87 Congress 1 Session (1961), *passim.*

[50] On early efforts by New Orleans to secure a river-lake connection see *Laws Relating to Rivers and Harbors*, I, 20; *Annual Report* (1868), 486-496. It will be recalled that such a connection (resembling the Industrial Canal) was seen as a part of an intracoastal waterway system by Brig. Gen. Simon Bernard in 1826. (See Note 6, this Chapter.)

[51] *Commission Proceedings*, 1 November 1908, 1449-1450; 25 November 1970; *Annual Report* (1925), 810-911.

[52] *Laws Relating to Rivers and Harbors*, III, 1811.

[53] *House of Representatives Committee Document 46*, Committee on Rivers and Harbors, 71 Congress 2 Session (1930), 1.

[54] *Ibid.*, 1-2.

[55] *Ibid.*, 3. But see *House of Representatives Committee Report 46*, Committee on Rivers and Harbors, 71 Congress 2 Session (1930).

[56] *Annual Report* (1948), 1040; *House of Representatives Document 96*, 79 Congress 1 Session (1942).

[57] *House of Representatives Document 245*, 82 Congress 1 Session (1951) 1, 6.

[58] The Bureau of the Budget represented local contributions as amounting to only about nine-tenths of one percent, which may have been accurate with regard to direct costs but did not reflect the whole burden of the locality. The Chief of Engineers required that local interests supply all rights-of-way, maintain a projected highway bridge over the Outlet (a bridge whose construction, by the way, had already been authorized for the eastern Intracoastal Waterway), hold the United States free from all claims for damages, and "construct, maintain and operate terminal facilities commensurate with requirements for the expanded port." *Ibid.*, 5.

[59] *Ibid.*, 2-3.

[60] See speeches by Sens. Russell Long and Allen Ellender, *Congressional Record*, 84 Congress 2 Session (1956), CII, Pt. 4, 5027.

[61] Public Law 84-455. It has been alleged that the Louisiana delegation relaxed its opposition to the St. Lawrence Seaway in return for an understanding about the Gulf Outlet. A review of the New York *Times* coverage for the Seaway, however, indicates such strong support (including President Eisenhower's) that the project had probably become an inevitability regardless of such opposition. Of course it is likely that Louisiana would have tried to salvage what it could from the situation; but it is noticeable that 2 years elapsed between the passage of the seaway legislation and the authroization of the outlet. Probably the publication of personal memoirs will have to be awaited before the inner history of the outlet can be uncovered fully. See the New York *Times*, 14 May 1954, 16; 20 January 1954, 17; 19 January 1954, 17.

[62] *House of Representatives Document 740*, 63 Congress 2 Session (1914), I, 681-688.

[63] During 1898-1909 the Corps improved Bayou Plaquemine as a connection to the Mississippi, providing it with a lock at the town of Plaquemine a few miles south of Baton Rouge. See *Annual Report*

(1898), 1471; *Annual Report* (1909), 1460. This link has now been discontinued.

[64] Article "Lake Charles," *Encyclopedia Brittanica* (Chicago: The Encyclopedia Brittanica, Inc., 1939), XIII, 601.

[65] *House of Representatives Document 46*, 46 Congress 3 Session (1871); *Annual Report* (1881), 1301.

[66] *House of Representatives Document 299*, 75 Congress 1 Session (1937).

[67] *Annual Report* (1941), 863.

[68] The lock was built to protect the basin of the Mermentau from salt water intrusion — another clear indication that the problem was foreseen.

CHAPTER SIX

[1] War Department, Office of the Chief of Engineers. General Order 15, 7 October 1929, Pars. 2 and 3. A copy of this order can be found in the Library of the Mississippi River Commission, Vicksburg, Miss.

[2] *Annual Report* (1941), 798. The change occurred on 1 November 1940, Lt. Col. C. Kittrell of the Second New Orleans District becoming Engineer of the combined district.

[3] Interview with George H. Hudson, 1970.

[4] Unpublished District History, in "Historical Summaries of Public Works," Library of the Mississippi River Commission, Vicksburg, Miss. See also *Annual Report* (1941), 5; Blanche D. Koll *et al., The Technical Services. The Corps of Engineers: Troops and Equipment* (Washington: Government Printing Office, 1958), 9 *et seq.*

[5] Interview with George H. Hudson, 1970.

[6] See Public Law 71, 84 Congress 1 Session, 15 June 1955.

[7] *Hurricane Study: History of Hurricane Occurrence Along Coastal Louisiana* (New Orleans: U.S. Army Engineer District, 1961), 1-34. See also Dumont de Montigny, *History of Louisiana*, 24 *et seq.*; Isaac Monroe Cline, *Tropical Cyclones* (New York, 1955), 24-25; and Harrison, *Alluvial Empire*, 43.

[8] The Federal Disaster Act of 1950 (Public Law 875-81) authorized the President to proclaim disaster areas and made a variety of assistance available to the victims.

[9] *House of Representatives Document 231*, 89 Congress 1 Session (1965), 46-47.

[10] *Ibid.*, 47.

[11] *Hurricane Betsy, September 8-11, 1965* (New Orleans: U.S. Army Engineer District, 1965), *passim*; Public Law 89-298, 89 Congress, 27 October 1965 (79 Stat. 1073).

[12] See *Annual Report* (1968), 427. The value of the work already done is suggested by a map of Hurricane Camille's flooding pattern, in *Report on Hurricane Camille* (New Orleans: U.S. Army Engineer District, 1970), Exhibit 49. Compare with *Hurricane Betsy*, Plates 5-11. On south Louisiana, see *Hurricane Camille*, Exhibits 46-47.

[13] Public Law 99-84 as amended by Section 206 of 33 U.S. Code 701n (the Flood Control Act of 1962) deals with Corps duties during emergencies. Public Law 875-81 deals with disaster planning and relief before and after such emergencies.

[14] See *Engineer Regulation 500-1-1*, 1 September 1967, as amended.

[15] *Ibid.*, Par. 22.10-22.13.

[16] *Ibid.*, Par. 22.33.

[17] *Ibid.*, Par. 22.412.

[18] *Hurricane Betsy*, 8.

[19] The brief sketch given here refers only to the immediate period of the disaster. The Coast Guard, the Department of Helath, Education and Welfare, the General Services Administration, the Federal Housing Administration, the Small Business Administration, the Department of Labor, the Federal Bureau of Investigation, and a variety of other agencies may become involved in the complicated problems resulting from the destruction of property and the dangers of public health and safety that follow a storm. See e.g. *Hurricane Betsy*, 12-13.

[20] Interview with Milton Rider, 1971.

[21] *Annual Report* (1909), 511.

[22] See Chapter One.

[23] *Annual Report* (1909), 511. See also *Annual Report* (1893), 1908 and the remarkable map in *Annual Report* (1882), 1542.

[24] *Annual Report* (1882), 1540.

[25] *Annual Report* (1893), 1902-1904. References to specific acts of Congress will be found in *Annual Report* (1909), 511-512.

[26] *Ibid.*, 512; *Laws Relating to Rivers and Har-*

bors, I, 632. For the "plan of Captain Willard" mentioned in the law, see *Annual Report* (1892), 1905, which given the general principles on which the Vicksburg Engineer Office proposed to treat the Red.

[27] *Ibid.*, 513.

[28] See the following citations in the *Annual Reports*: (1911), 624; (1913), 2314; (1914), 2361; (1915), 2692; (1916), 2539; (1917), 2626.

[29] *Annual Report* (1921), 888; (1924), 941.

[30] *Comprehensive Basin Study: Red River Below Denison Dam* (New Orleans: U.S. Army Engineer District, 1968), II, Appendix I, 4-5; I, 81.

[31] Cited in Irving K. Fox and Isabel Picken, *The Upstream-Downstream Controversy in the Arkansas-White-Red Basins Survey*, Inter-University Case Program No. 55 (Indianapolis and New York: Bobbs-Merrill, 1960), 5.

[32] *Ibid.*, 5-6 and *passim*.

[33] The Federal agencies were the Corps, the Federal Power Commission, and the Departments of Agriculture, Commerce, Health, Education and Welfare, and Interior. The chairman was Col. Thomas J. Bowen, New Orleans District Engineer. Much of the practical work must be credited to Frederic M. Chatry, currently Chief of the Basin Planning Branch of the New Orleans District. The interim plan owed much to the work of Jerome C. Baehr and John Gentilich.

[34] The cost-benefit ratio of the Shreveport to Daingerfield section is barely in excess of unity (1.02 to 1) and in the present political atmosphere this portion of the project has an extremely doubtful future.

[35] *Red River Study*, I, 90-91; 115. Work on the Kisatchie survey has been suspended at the request of the Louisiana Department of Public Works. This work is a subject of heated debate because it would flood part of Kisatchie National Forest.

[36] Remarks by Col. Herbert R. Haar, Jr., before the Red River Association at Shreveport, La., 29 October 1970.

[37] Col. Herbert R. Haar, Jr., "The Red River Waterway Project," *The Military Engineer*; to be published.

[38] "In 1969 the Arkansas River Waterway carried two and a quarter million tons of commerce, even though it was in operation only about 8 months of the year. This past year of 1970, the tonnage was almost 3½ million. During the year, the amount of new jobs created so far is well over 13,000." Remarks by Lt. Gen. F. J. Clarke at Water Resources Associated, Chicago, Ill., 31 January 1971. Gen. Clarke is the present Chief of Engineers.

[39] Raymond F. Dasmann *et al.*, *Environmental Impact of the Cross-Florida Barge Canal with Special Emphasis on the Oklawaha Regional Ecosystem* (Gainesville: Florida Defenders of the Environment, 1971), III.

[40] *House of Representatives Document 251*, 89 Congress 1 Session (1965), 4.

[41] See *House of Representatives Document 582*, 87 Congress 2 Session (1962), vii-viii. On cost-sharing, see *House of Representatives Document 169*, 88 Congress 1 Session (1963), *passim*.

[42] Interviews with Herbert Juneau, Lafayette Area Engineer, 1971; interview with A. H. Davis, Calcasieu Lockmaster, 1971; interview with Warren B. Dodd, 1971.

[43] *Laws Relating to Rivers and Harbors*, II, 888.

[44] Interview with Warren B. Dodd, 1971.

[45] In the case of Boca Ciega Bay, Florida.

[46] Col. Herbert R. Harr, Jr., "Address to the Joint Committee on Environmental Quality," delivered on 21 January 1971, at New Orleans. Copies of this and other cited addresses can be obtained from the Public Affairs Officer of the New Orleans District.

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DISTRICT ENGINEERS, NEW ORLEANS

RESIDENT MILITARY ENGINEERS, NEW ORLEANS[1]
Under Superintending Engineer for Gulf of Mexico Frontier

Captain	James Gadsden[2]	1818[3]	
Captain	W. H. Chase[2]		1828[4]
2nd Lt.	A. H. Bowman	Feb 1833	Jun 1833[5]
Captain	J. G. Barnard	Mar 1840	Dec 1847[6]
1st Lt.	P.G.T. Beauregard	May 1841	Nov 1846[7]
1st Lt.	Henry L. Smith	Nov 1846	Jun 1848
Captain	J. G. Barnard	Jun 1848	Nov 1852
1st Lt. (Bvt. Maj.)	P.G.T. Beauregard	Jun 1848	Apr 1857

Under Board of Engineers for the Gulf Coast

Captain (Bvt. Maj.)	P.G.T. Beauregard	Apr 1857	Jan 1861
Bvt. 2nd Lt.	W. H. McFarland	Jan 1861[8]	

CHIEF ENGINEER, DEPARTMENT OF THE GULF
Under Commanding General, Department of the Gulf (USA)

1st Lt.	Godfrey Weitzel	Mar 1862	Dec 1862
1st Lt.	D. C. Houston	Dec 1862	Jul 1864
Captain	Peter C. Hains	Jul 1864	Jun 1865
Captain	Miles D. McAlester	Jun 1865[9]	

NEW ORLEANS ENGINEER OFFICE
Under the Board of Engineers, New York

Major	Miles D. McAlester		Nov 1868
Major	F. E. Prime	Nov 1868	Apr 1869
1st Lt.	D. W. Payne	Apr 1869	Jun 1869
Captain	Charles W. Howell	Jun 1869	1881
Major	Amos Stickney	Dec 1881	Jul 1884
Captain	Thomas Turtle	Jul 1884	Feb 1885
Major	D. W. Heuer	Feb 1885	Oct 1887

Under Southwest Division (HQ New York)

Captain	W. L. Fisk	Nov 1887	Jan 1891
Major	James B. Quinn	Feb 1891	Nov 1899
Major	M. H. Adams	Dec 1899	Jun 1901
1st Lt.	E. M. Adams (Temp)	Jun 1901	Jul 1901

Under Gulf Division, New Orleans
After 24 July 1901

Lieut.	E. M. Adams (Temp)	Jul 1901	Oct 1901
Lt. Col.	Henry M. Adams	Oct 1901	Aug 1904
Lt. Col.	Clinton B. Sears	Aug 1904	Jul 1906
Colonel	E. H. Ruffner	Jul 1906	Jul 1907
Major	James F. McIndoe (Temp)	Jul 1907	Sep 1907
Colonel	E. H. Ruffner	Sep 1907	Aug 1908
Lt. Col.	Lansing H. Beach	Aug 1908	Jun 1911
Major	Harry Burgess (Temp)	Jun 1911	Sep 1911
Lt. Col.	Lansing H. Beach	Oct 1911	Aug 1912
Major	E. H. Schulz	Aug 1912	

NEW ORLEANS ENGINEER DISTRICT
Under Gulf Division, New Orleans, La.

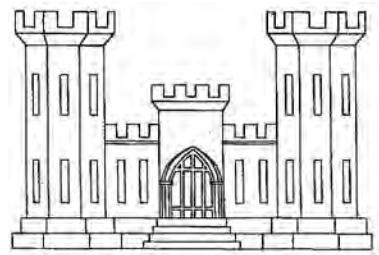
Major	E. H. Schulz		Oct 1916
Major	Julian L. Schley	Oct 1916	May 1917
Colonel	J. C. Sanford	Jun 1917	Nov 1917
Mister	T. E. L. Lipsey	Nov 1917	Mar 1919
Major	E. J. Dent	Apr 1919	Sep 1919
Colonel	Herbert Deakyne	Sep 1919	Feb 1920
Major	E. J. Dent	Mar 1920	Dec 1923
Colonel	C. McD. Townsend	Dec 1923	Jun 1926
Major	Malcolm Elliot	Jun 1926	Oct 1927
Captain	Lewis A. Pick	Oct 1927	Jul 1928
Major	R. F. Fowler	Jul 1928	

FIRST NEW ORLEANS DISTRICT
Under Gulf Division, New Orleans, La.

Major	R. F. Fowler		Jun 1932
Lt. Col.	Max C. Tyler	Jun 1932	Nov 1932
Major	Henry Hutchins, Jr.	Dec 1932	Jul 1936
Lt. Col.	Robert W. Crawford	Jul 1936	Mar 1938
Lt. Col.	L. W. Miller	Mar 1938	Aug 1939
Captain	Robert G. Lovell	Aug 1939	Nov 1940

NEW ORLEANS DISTRICT
Under Lower Mississippi Valley Division,
Vicksburg, Miss.

Lt. Col.	Clark Kittrell	Nov 1940	Jan 1942
Colonel	Dewitt C. Jones	Jan 1942	Apr 1943
Colonel	George H. Hudson	Apr 1943	Jul 1945
Colonel	Fisher S. Blinn	Jul 1945	Feb 1946
Colonel	Leonard B. Gallagher	Mar 1946	Mar 1947
Colonel	John R. Hardin	Mar 1947	Jul 1949
Colonel	Charles G. Holle	Jul 1949	Apr 1953
Colonel	Charles T. Tench	Apr 1953	Jun 1955
Colonel	William H. Lewis	Jul 1955	Aug 1958
Colonel	George C. Cookson	Aug 1958	Aug 1961
Colonel	Edward B. Jennings	Aug 1961	Jul 1964
Colonel	Thomas J. Bowen	Aug 1964	Jul 1968
Colonel	Herbert R. Haar, Jr.	Aug 1968	Jul 1971
Colonel	Richard L. Hunt	Jul 1971	



FOURTH MRC DISTRICT
Under the Mississippi River Commission,
New York and St. Louis

Captain	A. M. Miller	1882	
Colonel	Amos Stickney	Aug 1882	Feb 1886
Major	Charles W. Raymond	Feb 1886	Dec 1886
Captain	Dan C. Kingman	Dec 1886	Oct 1890
Captain	John Millis	Oct 1890	Oct 1894
Major	James B. Quinn	Nov 1894	Nov 1894
Captain	George McC. Derby	Nov 1894	Jun 1898
Major	J. H. Willard	Jun 1898	Nov 1898
Captain	Henry Jervey	Dec 1898	Mar 1899
Major	George McC. Derby	Mar 1899	Sep 1902
Captain	Charles S. Bromwell	Oct 1902	May 1904
Lt. Col.	Henry M. Adams	May 1904	Jul 1904
Major	James F. McIndoe	Jul 1904	Sep 1907
1st Lt.	Wilbur Willing	1908	
Major	Harry Burgess	Aug 1908	Jul 1910
Captain	Robert H. Ralston	Jul 1910	Dec 1910
Major	Harry Burgess	Dec 1910	Dec 1911
Major	Clarence O. Sherrill	Dec 1911	Aug 1914
Major	W. G. Caples	Sep 1914	Nov 1916
Major	Richard C. Moore	Dec 1916	Apr 1917
Captain	Beverly C. Dunn	May 1917	
Lt. Col.	George M. Derby	May 1917	Aug 1919
Colonel	H. S. Hetrick	Aug 1919	Jan 1920
Major	E. J. Dent	Jan 1920	Feb 1920
Colonel	J. Franklin Bell	Feb 1920	Sep 1920
Major	R. T. Coiner	Sep 1920	May 1924
Major	H. S. Bennion	May 1924	Aug 1926
Major	W. H. Holcombe	Aug 1926	

NEW ORLEANS RIVER DISTRICT
Under Lower Mississippi Valley Division,
Vicksburg, Miss.

Major	W. H. Holcombe	Sep 1928

SECOND NEW ORLEANS DISTRICT
Under Lower Mississippi Valley Division,
Vicksburg, Miss.

Major	W. H. Holcombe		Apr 1931
Lt. Col.	J. N. Hodges	Apr 1931	Aug 1935
Lt. Col.	J. H. Carruth	Aug 1935	May 1936
Lt. Col.	William F. Thompkins	May 1936	Jul 1940
Lt. Col.	Clark Kittrell	Jul 1940	Nov 1940

[1] Not an official title.

[2] Superintending Engineer.

[3] *Monthly Returns* missing 1819-1832.

[4] Moved to Pensacola 1828.

[5] *Returns* show no officers permanently at New Orleans, 1834-1840.

[6] Duties at N.O. divided between Beauregard and Barnard.

[7] Ordered to duty in Mexico.

[8] Forts seized by troops of State of La., 12 Jan 1861.

[9] Title changed Jul 1865 to "Chief Engr. Dept. of La."

APPENDIX II

THE CORPS OF ENGINEERS IN LOUISIANA

MISSION: The development, construction, operation and maintenance of water resources for flood control, navigation, water supply, water quality control, fish and wildlife augmentation, recreation and related purposes. Collection and publication of statistical data on usage of navigable waterways.

CIVIL WORKS EXPENDITURES THROUGH 30 JUNE 1970	$1,460,977,000
CIVIL WORKS FUNDS AVAILABLE FOR EXPENDITURE IN 1971	$ 97,147,000
PERMANENT EMPLOYEES	1,342
ANNUAL PAYROLL	$ 15,600,000
MILES OF NAVIGABLE WATERWAYS DEVELOPED AND MAINTAINED IN STATE	2,853
GROSS TONNAGE OVER STATE WATERWAYS DURING 1968	655,040,809

NATIONAL RANKING OF STATE DEEP-DRAFT PORTS IN TONNAGE HANDLED DURING 1968

NEW ORLEANS — SECOND	113,511,052 tons
BATON ROUGE — SEVENTH	37,872,394 tons
LAKE CHARLES — TWENTIETH	15,451,523 tons

APPENDIX III

DISTINGUISHED CIVILIANS[1]

Nicholas Balovich	Construction Superintendant, Operations Division
Robert N. Bruce	Chief, Construction Division
Horace L. Dear	Chief, Navigation Branch
Lizzamond A. Jeanfreau	Navigation Specialist, Operations Division
John E. Kennedy	Assistant Chief, Operations Division
W. B. Smith	Chief, Operations Division
Horace A. Thompson	Chief, Operations Division
Herbert L. Williams	Supervisory Structural Engineer

[1] These are distinguished civilian employees who have been singled out by the New Orleans District for recognition. All are now retired, and are associated with the District's work during the past generation.

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Hurricanes: Staff